THE
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ELECTRICAL REVIEW.

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THE WAR AND FUTURE TRADE.

IN the early days of the war, when the production of war requirements for ourselves and our Allies was not engrossing the attention of between two and three thousand British factories, and when the closing of the Home and overseas markets to German manufactures possessed more of novelty than it does now, there was a considerable liveliness in agitations for the formulation of a future trade policy which should appropriately express our national determination to be more independent of Germany. In the interests of manufacturers who were perplexed as to whether it would prove worth while to commit themselves to capital expenditure for the production of new lines, we ourselves expressed the hope that the Government would see fit to appoint a Commission to report on certain aspects of the new situation. Though we do not find it necessary to withdraw from the position that we then assumed, we have to recognise that as the months have passed by, the trade war agitation in these islands at least has become much subdued. The lull is in all probability only temporary, and at a later date the movement will doubtless gather even greater force than characterised it a few months ago. That there should be this comparative pause is most natural and reasonable when we consider the unparalleled extent of the struggle in which we are engaged, and the strange and tragic experiences through which we are passing.

The determination to crush Prussian militarism is as strong as ever in the mind and heart of Britain, and we with France and Russia, Belgium and Serbia, are paying the huge and inevitable price, and while we are so strenuously engaged with this and all the thousand things that it means, touching our lives on every side, we can hardly expect to gain an attentive and sympathetic ear either from legislators or from the common people for matters appertaining to future trade, however vital they may seem to us.

There are very many things that we should like to see the Government do to assist the British manufacturer to put up a more successful fight against the German industrial and trading systems, and probably one or two more special war-time Committees will be added to the 30 or 40 that have already been appointed, which will have such matters expressly relegated to them. But it seems that it must of necessity be a long time before this present or any other Government will be able to formulate an after-the-war trade policy for the United Kingdom, for it must in a large measure be affected by the course things take both in the remaining period of hostilities and in the complicated and lengthy negotiations which will settle the terms of permanent peace.

It becomes more and more obvious as we study the problems of peace, even as superficially as is possible at this date, that that stage of this world conflagration will be only slightly less difficult than are our vast and unprecedented Naval and Military operations. And who can say what will be the nature of questions then arising which shall affect our future trading relations with the millions of people who will remain in what we now know as the German

and Austrian Empires? Notwithstanding all the obscurity in which such matters are necessarily involved at present, there is undoubtedly deep down in the British breast a fixed determination that German manufactures shall never have the place here in the future that they have occupied in the past. Already measures have been taken, under the compulsion exerted by the closing of the market to enemy goods, and because of the more favourable opportunities that the same circumstance has afforded us, which will go some way toward enabling British works to carry that determination into effect when trading relations, on whatever basis may be ordained, are resumed between the industrial nations of Europe. Every month that the war is prolonged and the British Navy prevents enemy countries exporting manufactured goods, the position of Teutonic export trade becomes weaker, and the task of its ultimate recovery is made more difficult. Meanwhile, we shall go on exporting as energetically as the Government war demands will permit, and the information and organisation of the Board of Trade will continue to be placed at our disposal. May we hope that in readiness for whatever may be the new state of things when hostilities cease, the Board of Trade's recent activities will be carried a step or two further? We trust that Mr. Runciman will recognise the need that exists for a measure of modernisation and organisation with certain supplementary alterations making for greater efficiency and usefulness, supposing that he cannot see his way to adopt the proposals that are being again advanced in some of the more ambitious schemes that have been put before him by critics and advisers.

Whatever may be our views in regard to the adoption of a new trade policy for the United Kingdom, it is clear that our blood relations in the Colonies are freer than we are from some of the hampering influences. It has been already stated that the Colonies will be taken fully into consultation whenever the happy but difficult days of peace deliberations arrive. It will be but reasonable, too, that they be allowed to have a voice in the formulation of a future British world trade policy. They have given to the Mother Country, to the Empire, to the general cause of Civilization, of their best in both blood and treasure, and they have a pretty clear idea of the need for a strong policy for the future so that no repetition of these terrible experiences shall be possible. And from what we have read of Colonial newspaper and other comment, in regard to no other aspect of the situation are they so determined as in relation to the prevention of future Teutonic commercial supremacy in their lands. We receive letters from Australia with envelopes bearing the legend: "Don't let German goods in after the War!" "Why should Germans have a Vote in this country?" This attitude is also reflected in letters in the Australian Press where public men write: "Unless we frame an after-the-war policy, which does not include the German and his friends, we are going to have some pretty strenuous times in Australia during the next few years." "Immediately the war is over, Germany will endeavour, at all costs, to recapture her lost foreign trade, and we may reasonably expect she will flood the world with low-priced German goods. What sacrifices will she not make in order to undersell her opponents, and once again gain access to foreign markets?" Thinking in this strain, it is small wonder that some authorities there who have British interests at heart hold that this menace constitutes a grave danger to Australia, and are asking for the strongest possible policy to be adopted. Of course, the Colonies are freer from restriction than we are in dealing with import trade, and in whatever measures they see fit to introduce they will be but consistently following along the preferential lines that they have hitherto adopted. Here, of course, the position is not so easily handled, where departure from principle or long approved policy is involved. But we shall be wise if in the Home Country we keep ourselves fully informed as to the attitude of the Colonial mind, and the thoroughness which they desire to adopt in excluding the enemy from trading operations in their lands in future. Only this week we have received from an esteemed correspondent in Victoria a piece of news which shows which way the wind is blowing. Failing ability to completely exclude German or Austrian goods, they will make it as difficult as possible for them to compete with British-made manufactures. To that end the Berwick Shire Council on March 22nd unanimously carried the following resolution:—

That the Council circularise all municipalities, inviting their co-operation in urging the Government to place a duty of 50 per cent. on all German goods imported, and all goods of German manufacture that might be made in other countries after the war.

We quote this as an illustration of the Australian trade agitation that is spreading; all the municipalities in Victoria, at least, are being approached. The importance of the matter to our readers lies in the fact that Germany has in the past had so strong a position in the Australian electrical field, and Australians, in adopting this British trade policy, are anxious to have the fullest possible co-operation and support from our manufacturers in the United Kingdom.

Lead.

THERE has been an irregular and weaker tendency observable lately in lead. The restraint which has been put upon export trade has had a notable influence in reducing the premium upon early deliveries, and has thus brought about much healthier fundamental conditions, while the reduction in price will eventually stimulate buying. Prompt lead at one time sold down to about £20 10s., but the fall to this level was brief, for at the reduced prices the metal looked cheap, and buyers came forward in large numbers to take advantage of their opportunities, a large business being done, particularly by France, while speculators have displayed increased activity. At the same time export business is much restricted, and the recent closing of navigation with Holland put a further obstacle in the way of shippers of lead. Now that communication with Holland has been reopened, it is probable that fair quantities of lead may be shipped there from here, while export demands are likely to undergo considerable expansion from other quarters. From time to time considerable business has been done for shipment to Russia, but there are still difficulties in the way of obtaining shipping permits, and there is a decided abundance of lead available for early delivery.

While the United States has not been exactly pressing lead, there are indications that considerable quantities are available across the Atlantic, and at any improved level of prices it is thought that sellers in America will again display more interest in the European position. As regards the home trade, activities have been rather in a state of suspense, but there seems to be some small indication of an improvement in demand, though general trade can hardly assume anything like normal proportions in these days of almost universal warfare.

There can hardly be much reduction from the current level of prices, though temporary fluctuations are to be expected. The general trend of sentiment seems now to be slightly in favour of higher prices. It must be borne in mind that the authorities are determined as far as possible to prevent any undue appreciation in the price of early over distant deliveries. There is no doubt that they would have no hesitation whatever in enforcing an entire cessation of shipments from this country, if circumstances appeared to justify the taking up of such a position. The world's requirements are exceedingly heavy and practically confined, of course, to the production of war munitions, hence the integrity of the British market so far as national requirements here are concerned becomes a matter of vital importance. Under no circumstances will any outside consideration be permitted to interfere with this necessity.

The position in the United States has varied but little, the conditions being regarded as intrinsically sound, and very little interest has been taken in the movements notified from the London market. The home trade demand across the Atlantic is rather poor, but this is bound to improve owing to the large ammunition orders which are being executed for the allied Powers, and independent producers are so well sold up that they are not offering metal for anything earlier than June shipment. It is commented upon as very curious that the war should so far have had but a trifling effect upon lead prices, while it has quadrupled the price of antimony, trebled the price of spelter, and added about 50 per cent. to the price of copper.

The Kenotron. We have often remarked upon the importance of scientific research, and the illimitable field which still remains open to investigators, and recent developments have emphasised these points. Unfortunately, they seem to be more fully realised abroad than at home.

In the early days, when electrical discoveries could be made with simple apparatus and scanty resources, this country led the world in scientific progress. At a later date, while our manufacturers were busily cultivating the industrial—and, alas! the financial—fields thus thrown open to them, the Germans, with their keen appreciation of the value of science to industry, forged ahead, but were always handicapped by their deficiencies on the practical side. The United States, while fertile in ideas, and quick to grasp the commercial possibilities of a new invention, erred like ourselves in undervaluing scientific research, but not many years ago the General Electric Co. awoke to a realisation of the facts, and established at immense cost a special laboratory for research, which was equipped with apparatus *ad libitum*, and a staff of investigators of the highest ability. Thanks to the admirable combination of commercial acumen with scientific insight, the result has been the evolution of a series of inventions of the highest importance to mankind, of which the laboratory may be justly proud. Foremost amongst these are drawn tungsten wire, the nitrogen-filled lamp, and the Coolidge X-ray tube; but the laboratory is not content with working on narrow lines towards set objects such as these; its scope is far wider—and the fruits of its labours have been, and no doubt will be, correspondingly rich and abundant.

The staff of researchers sets to work to find out all that can be discovered in a particular field, and accomplishes its task with skill and thoroughness that compel our admiration; and when the facts have been discovered and principles deduced from them, the way is clear to turn them to some practical use. Nor do the investigators neglect to avail themselves of the fruits of the work of others in kindred fields; and thus it is that the "Kenotron" has been brought into existence.

Starting with the "Edison effect" as basis, from which Dr. Fleming had developed the "valve" so useful in wireless telegraphy, the investigators brought to bear upon this embryo rectifier the powerful resources of the Research Laboratory. They had at command unrivalled facilities for the production of vacua of a degree hitherto unattainable—be it noted that they employed the Gaede pump, which drags out the individual molecules of air—and by this means they found out the cause of the erratic behaviour of the valve previously observed, and reduced the phenomena to order and discipline, so that they could be reproduced at will. In this work they had the benefit of the scientific work of an Englishman, O. W. Richardson, who had covered a good deal of the ground. In the end they produced an instrument subject to perfectly definite laws, and having an extremely high efficiency; it is true that at present it has been constructed only for small currents, but it deals with enormous voltages—100,000 to 200,000 volts—and already a single kenotron can rectify 10 KW. The device is as yet in its infancy, but, as Dr. Dushman points out, it offers great possibilities.

The most striking feature of this new instrument is the fact that it depends for its operation upon the discharge of a stream of electrons from a heated body in an almost perfect vacuum, under the influence of an applied potential difference—a discharge which is unidirectional. It utilises the fundamental principles of electric flow, as now understood, and at the same time affords a singularly convincing demonstration of the truth of the theory itself. The current is conveyed through empty space by particles of negative electricity, each $\frac{1}{1800}$th of the mass of an atom of hydrogen. Surely the thought of that swarm of infinitesimal particles hurrying to do our bidding should inspire us with hope for the future unravelling of the mystery of the ether, and the unlocking of the secrets of the energy contained in the molecules of matter.

THE NATIONAL ELECTRICAL CODE REVISED.

By FRANK BROADBENT, M.I.E.E.

The National Electrical Code, which is the American equivalent to our Institution and other Rules relating to electrical installations, has just undergone its biennial revision. As was pointed out recently in these columns (*) the Code is rendered unnecessarily bulky by the inclusion of detailed specifications relating to the manufacture and testing of cables and apparatus, regulations which do not very greatly concern the wireman or contractor working under the National Code, inasmuch as his responsibility ends by specifying in his orders to the manufacturer that the material must have received the official approval of the National Board of Fire Underwriters.

It is, therefore, interesting to note that it is now proposed to omit these detailed specifications from the Code, and to include only skeleton outlines of the requirements. The manufacturing specifications referred to will be published separately and will, therefore, be available for those whom they particularly concern.

The method of revision of the National Code differs somewhat from that adopted by our own Institution, where the regular practice is to appoint a Revision Committee, which has power to consult interested parties or experts in the various branches of installation work, and, having come to a decision, the Committee has power to make such revisions as it may consider necessary or desirable.

In America the opposite course is adopted; the Committee first of all revises the rules, and then a public meeting is called to vote upon the details of the proposed revision. If such a practice were adopted here, it is doubtful if half-a-dozen persons besides the members of the Revision Committee would think it worth while to attend at the Institution premises on the Embankment in order to record their views and votes. In marked contrast to this apparent apathy, the American meetings are well attended and the subjects vigorously discussed. At the meeting held on March 24th, in the premises of the New York Board of Fire Underwriters, to consider the suggested modifications in the Code and to go over the reports of the various sub-committees, the auditorium was filled to its utmost capacity, a portion of the audience being able to secure only standing room.

One of the points which gave rise to considerable discussion was the use of refillable fuses, by which is meant what we should call cartridge fuses. It was supposed that the use of refillable fuses would largely, if not entirely, prevent the abuse to which the ordinary open type of fuse is subjected. The Electrical Committee had recommended a further trial of refillable fuses and the accumulation of more experience. This was strongly opposed by several speakers, who contended that refillable fuses were unsafe, that they were just as liable to abuse as the old types, and that further experiment was quite unnecessary.

The Committee's recommendation was finally defeated, and the following resolution adopted:—

It is the opinion of the Committee that experience has not yet shown that fuses in which the fuse element is intended to be replaced or renewed by the user are satisfactory in test or in field service to a degree warranting the recognition of the principle of refillable fuses in the rules of the National Electrical Code.

This resolution, it would appear, bears hardly on those manufacturers who, during the period of probation, had standardised replaceable fuses in the hope and expectation that this type of fuse had come to stay, and it is not surprising, therefore, to learn that representatives of some of the manufacturers present questioned the authority of the meeting to quash the Electricity Committee's recommendations. The protest, however, was without effect, as it was held by the Chairman that the final court of appeal was "a meeting of the public interested in the subject." In view of the headway which the replaceable type of fuse has made in this country, the above decision is particularly interesting to English electricians.

In our rules we have as yet nothing specifically referring to the installation of "gas-filled lamps," but the

* Reference is to the author's recent article on The National Code and British Wiring Rules.

National Code recognises their use, and, among other rules, the following now appears :—

Must not be used in shop windows or in other locations where inflammable material is liable to come into contact with lamp equipment, except where used in connection with approved fixtures where temperature of any exposed portion of same does not exceed 200° F.

This rule will, no doubt, cover mercury-vapour lamps, Moore tubes, half-watt lamps, and others in which the vacuum principle is not used.

Another point in which the National Code differs from our own rules is that the carrying capacity of wires used in connection with motors must be higher than for lamp circuits. Formerly the National Code specified that all conductors on motor circuits must be designed to carry a current at least 25 per cent. greater than the rated motor current. This rule is now altered to read as follows : —

Wires carrying the current of only one motor must be designed to carry a current at least 25 per cent. greater than that for which the motor is rated.

From this it would now appear that the wires to individual motors must have a 25 per cent. margin, whereas the main circuit conductors feeding a distributing-box from which several motors are fed need not be so highly rated.

On the subject of "service wires" the rules neither of the Institution nor the Home Office are concerned, this subject coming within the jurisdiction of the Board of Trade, assuming the supply to be given from outside under B. of T. regulations. On a self-contained installation, however, in which there are several blocks of buildings connected to the generating plant through outside wires, the latter would be regarded as service wires, and these would then come within the scope of our Institution rules, and, in the case of a factory, under the Home Office rules also. On this subject a new paragraph has now been added to the National Code to the effect that metal conduits containing service wires must be insulated from the metal conduit or armouring of cables, or any other metal on or near the building. Alternatively they must be permanently and effectively earthed to water or gas piping, or other suitable earths. If earthed to gas piping, the connection must be on the street side of the gas meter. The earth connection must, however, be in addition to any other earth connection on the metal conduit or armouring within the building. The reason for this rule is not quite obvious, as if all the earth connections are properly made there would appear to be no reason why they should not be bonded together, and it is common practice here to bond the interior conduit system to the supply sheathing, and to rely upon that for "earthing."

Another new paragraph which is not quite in accord with the general opinion obtaining in this country is that the main supply switch should be protected by the main cut-out, "unless the switch is of the knife-blade type and enclosed in an approved box or cabinet, under which conditions the switch may be placed between the source of supply and the cut-out." The standard practice in this country is to use nothing but the enclosed type for service switches, and although the practice has not yet been quite standardised, it is becoming more and more the custom to protect the fuse or cut-out by the switch and not *vice versâ*; so that, in the event of a fuse requiring replacement, the terminals can be made dead by means of the switch. Under the Home Office requirements, this method is compulsory unless the fuses are of a switch-handle type which can be handled without risk of shock when the fuse terminals are alive.

In the former article already referred to, it was pointed out that, according to the Code, four two-wire and three three-wire circuits could be run in one metal tube; whereas, in this country, although there is no restriction in the Institution Rules, there are some local authorities who limit the number of conductors to four, which is, no doubt, a good practice. It is, therefore, interesting to observe that an amendment has now been made to the National Code, prescribing that not more than four No. 4 B. and S. gauge rubber-covered conductors shall be placed in metal conduit, and that no single lighting circuit shall carry more than 1,320 watts. There are many other modifications in the rules, but as these apply essentially to American practice they do not call for special comment.

THE KENOTRON RECTIFIER.

In the *General Electric Review* for March a description is given by Dr. Saul Dushman of a new device for rectifying high-pressure electric currents, called the "Kenotron" (from the Greek adjective *kenos*, meaning "empty," and the suffix *tron* signifying an instrument or appliance). This rectifier, which is one of the many products of the Research Laboratory of the General Electric Co., of Schenectady, is based upon the phenomena of emission of electrons from incandescent metals, which have been the subject of extended investigations by Dr. Irving Langmuir for several years; it will be remembered that Dr. Langmuir's results bore fruit in the development of the half-watt lamp and the Coolidge X-ray tube, and as the editor of our contemporary points out, "the construction of a high-voltage rectifier illustrates the old expression that the theory of the present may become engineering practice of the future."

The emission of negatively charged corpuscles or electrons from heated metals may be illustrated by the following arrangement. In an ordinary lamp bulb containing a tungsten or carbon filament there is also sealed in a metal plate. After the lamp is well exhausted it is observed, on charging the filament negatively (making it cathode) with respect to the plate, that a current passes across the vacuous space. If the filament is charged positively this current disappears. Furthermore, the magnitude of this electron emission (thermionic current) from the heated cathode increases with increase in the temperature of the filament.

This effect had been observed by Edison, and was more fully investigated in the case of carbon lamps by Fleming. In view of the unilateral conductivity possessed by such an arrangement as that described above, Fleming applied it as an "electric valve" to rectify electric oscillations such as are obtained from a "wireless" antenna, and therefore to render it possible for these oscillations to affect a galvanometer or telephone.

That the current from a hot cathode in an exhausted bulb is due to a convection of electrons, that is of negatively charged corpuscles having a mass which is about 1/1800th of that of a hydrogen atom, may be shown by deflecting the current in magnetic and electrostatic fields and determining the ratio e/n.

The subject was taken up by Dr. Langmuir, who found that in the case of heated tungsten filaments the electron emission at constant temperature increased as the vacuum improved until a constant value was attained, which varied with the temperature in accordance with an equation laid down by Richardson. In the types of hot-cathode rectifiers exhausted by ordinary methods, the electron emission is accompanied by a blue glow, and the cathode gradually disintegrates; it was found that the blue glow was due to the presence of positively charged gas molecules (ions), and that the disintegration of the cathode was due to bombardment by these ions. When the vacuum is made as perfect as possible, however, conduction occurs only by means of electrons emitted from the hot cathode, and there is no blue glow.

By means of a Gaede molecular pump in series with two other pumps, with a liquid-air trap between the rectifier and the molecular pump, Dr. Dushman has succeeded in attaining a vacuum as high as 5×10^{-7} mm. of mercury. The thermionic current in a high vacuum depends directly upon the nature of the electrodes and the temperature, values for tungsten being as follows :—

Absolute temperature.	Milliamperes per cm².
2 000	4·2
2 200	43·3
2 400	364·8
2 600	2,044·0

There is, however, another factor influencing the electron current, namely, the electrostatic field or "space charge," observed by Dr. Langmuir, which is set up by the electrons emitted from the hot cathode; the effect of this charge is that with a given voltage, the current increases with temperature, according to Richardson's equation, only up to a certain temperature, after which it remains constant. The higher the voltage between the electrodes, the higher is the

temperature at which the limit is reached, but in no case does the current at a given temperature exceed the value given by Richardson's equation, no matter what the voltage. As the absence of positive ions and therefore of gas is essential, the appropriateness of the name kenotron is obvious.

The current-carrying capacity of a kenotron, when given sufficiently high voltage between the electrodes, is limited only by the area of the surface emitting electrons and its temperature. It is necessary to limit the temperature to such a value that the life of the filament is at least 1,000 hours, and taking the life as the time required to evaporate 10 per cent. of the diameter, the following figures are obtained :—

Diam. of filament in mils.	Safe temperature (life over 2,000 hours).	Electron emission ma. per cm. length.	Heating watts per cm. length.
5	2,475	30	3·1
7	2,500	50	4·6
10	2,550	100	7·2
15	2,575	200	11·3

The space charge necessarily gives rise to a voltage drop in the kenotron ; the current is limited to the maximum value corresponding to the temperature, and if by any chance, such as a short circuit beyond the rectifier, an excessive voltage is thrown on the latter, the instrument will be in danger of destruction. Because of the high degree of vacuum, none of the electrons lose energy by collision with gas molecules ; the whole of their kinetic energy is therefore liberated as heat at the anode, like that of rifle bullets on an iron target, and the anode may thus be quickly melted. Moreover, if the anode is highly heated, rectification naturally becomes imperfect. The rectifier must, therefore, be protected against excessive pressure, and be so designed that the space charge voltage is not great enough to cause undue heating of the anode with the normal current. It is found that about 10 watts per sq. cm. of anode area is permissible, corresponding to a temperature of 1,600° absolute, a bright red heat ; at this temperature the electron emission from the anode is still less than 0·02 ma. per sq. cm.

Another important point in design is the prevention of electrostatic strains on the filament due to the high voltage, the electrostatic attraction between the electrodes being proportional to the square of the voltage. During the rectifying phase the P.D. is very low, but during the other half cycle the electrodes are subject to the full P.D. of the line. The space charge increases with the distance between the electrodes, so that they must be kept fairly close together. Various symmetrical arrangements, such as a straight filament in the axis of a cylindrical anode, a V or W-shaped filament between two parallel plates, or a headlight filament inside a molybdenum cap, have been devised to meet this difficulty. Figs. 1 to 3 are examples of these.

In fig. 1 a molybdenum cylinder A encloses a coaxial filament F. For direct-current pressures up to 15,000 volts the diameter of the cylinder need not exceed ½ in., while the length may be up to 4 in., with a 10-mil filament as cathode. At a temperature of 2,550° absolute the maximum current obtainable from such a kenotron is about 400 milliamperes, and the voltage drop is 145 volts.

The space-charge loss is therefore 58 watts, and the heating of the filament requires 72 watts, making a total loss of 130 watts in the rectifier, or 1·5 watts per sq. cm. of the anode, which attains a dull red heat. The kenotron is capable of rectifying 6 KW., so that the loss in the tube amounts to 2 per cent.

For D.C. pressures up to 75,000 or 100,000 volts, the diameter of the cylinder is increased to about 5 cm. A tube intended to rectify 10 KW. at 100,000 volts, with a carrying capacity, therefore, of 100 ma., had a loss of only 1·25 per cent.

The type of kenotron shown in fig. 2 is suitable for voltages not over 10,000, and currents ranging up to 100 ma. ; it consists of a small filament such as is used in automobile headlights, inserted in a molybdenum cap about ⅝ in. in diameter. The loss at 10,000 volts, 100 ma., is about 5 per cent.

A V-shaped filament between tungsten plates is shown in fig. 3, the plates being 2 to 4 cm. apart. A current of 100 ma. can be carried up to 40,000 volts with a space-charge voltage of 260 volts, the temperature of the filament being 2,500° absolute.

With two kenotrons, connected as in fig. 4, both half waves of the current can be rectified with a connection to

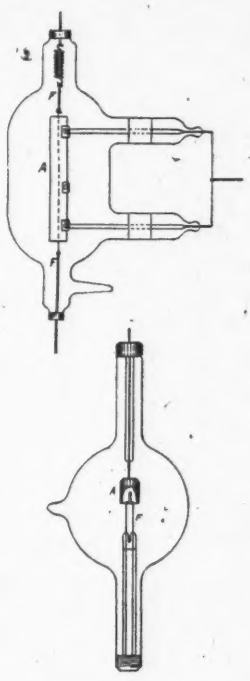

FIG. 1.—KENOTRON WITH CYLINDRICAL ANODE.
FIG. 2.—KENOTRON WITH MOLYBDENUM CAP.

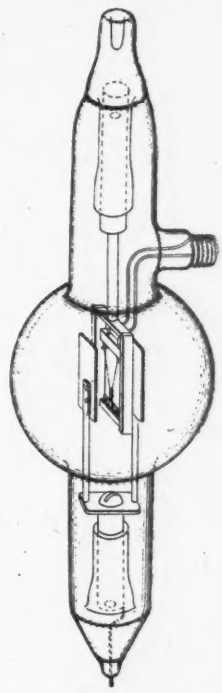

FIG. 3.—KENOTRON WITH FILAMENT BETWEEN PARALLEL PLATES.

the middle point of the transformer. Fig. 5 shows an arrangement of four kenotrons for utilising the full voltage of a transformer.

Kenotrons have been constructed for D.C. voltages up to 100,000 volts, and currents up to 1·5 amperes ; the author has every expectation of extending their application to 200,000 volts. It is preferable to construct them in the form of 10-KW. units when the voltage exceeds 25,000 ; for lower voltages, smaller units are advisable. Unlike the mercury-vapour rectifier, they can be operated in parallel.

In the laboratory the kenotron facilitates the production of small direct currents at very high voltages, for spectroscopic work, &c., and for testing the dielectric strength of insulation. By inserting capacity between the high-pressure D.C. terminals, as at C, fig. 4, the fluctuations in the direct

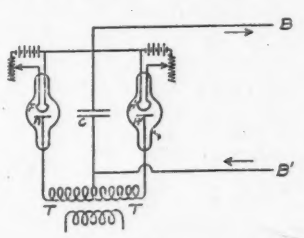

FIG. 4.

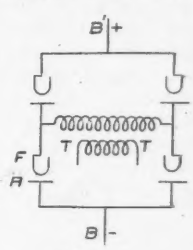

FIG. 5.

A F, A' F', kenotrons ; T T, transformer ; B B', D.C. mains ; C, condenser.

FIG. 4.—ARRANGEMENT FOR RECTIFYING BOTH HALF WAVES.

FIG. 5.—ARRANGEMENT FOR UTILISING FULL VOLTAGE OF TRANSFORMER.

current can be reduced to any desired extent. For the operation of X-ray tubes, the precipitation of dust, &c., the instrument is well adapted. But the author's vision is not restricted to minor uses such as these ; he regards high-voltage D.C. transmission as being "very much within the limits of possibility." "To transmit 1,000 KW. by 100 kenotrons, working in parallel at a voltage of 50,000 to 75,000, is quite a feasible proposition."

THE WAR AND THE ELECTRICAL INDUSTRY.

We have lately made further inquiries among a number of firms connected with the electrical industry in regard to the effect of the continuation of the war upon their operations.

Our inquiries related to the effect of the demands of the Government for war materials, the extent of present home and foreign business, the probable effects of restriction of municipal electrical expenditure, the wearing of badges by workpeople, the shortage of skilled labour, the shortage of raw materials, and the progress being made in the manufacture of new lines and with trading operations in new markets.

A firm of scientific instrument-makers replies as oll ows :—

Home and foreign orders are about up to the average. On account of the large amount of Government work in hand, however, it is not possible to actively push foreign business. No effect of limitation of municipal expenditure has yet been felt. About 20 per cent. of the men have enlisted. It is not anticipated that many more will do so voluntarily. Service badges have been obtained, but not yet issued pending an anticipated visit from the War Munitions Committee. The shortage of skilled labour is severely felt, and is greatly handicapping output. Shortage of raw material has not been seriously felt, but there are difficulties, of course, in obtaining deliveries.

Inquirers often ask for substitutes for Continental instrument-makers' goods, but the pressure of Government work has prevented any serious effort to enter new foreign markets.

The Walsall Electrical Co., Ltd., state :—

We have at the present time sufficient orders to keep our works more than fully occupied. We have secured a fair amount of Continental trade, most of which, as far as we can trace, has previously been transacted by the enemy.

The restriction of municipal expenditure will not materially affect us, as the slump in our standard lines has been more than counterbalanced by new business.

We are at present experiencing a great difficulty with labour, as something like 33⅓ per cent. of our staff and employés have joined the Colours and things are not improving.

We are having considerable difficulty in obtaining skilled labour —more so than unskilled ; this is materially affecting our deliveries. Our supply of material is very much restricted, and at the present time is causing serious inconvenience.

We have certainly started to manufacture new lines formerly purchased from the Continent, but it is impossible to say to what extent this business will prosper until the present difficulties have disappeared.

A well-known firm of makers of electrical instruments and apparatus writes :—

We are receiving orders freely both at home and abroad, but of course the bulk of our work is from this country, and it is largely dependent on the war. At the present moment we are not feeling the restriction of municipal electrical expenditure, but in connection with this we would point out that a large amount of such expenditure is necessary in order to keep war industries going. A considerable proportion of our men have enlisted, and we are feeling very considerably the loss of the services of the intermediate class of man. Material also is difficult to obtain, and is becoming increasingly dearer. There is always a certain amount of development going on in our works, but this is naturally directed at the present time to carrying out the various orders for the Government which we have in hand.

A large electrical manufacturing company reports :—

We continue to receive orders freely for our manufactures from buyers at home and abroad and have no complaint to make in this respect, but rather the other way about, that is, in some departments we receive orders much too freely for our comfort from the point of view of execution. We do not consider that the restriction of municipal electrical expenditure will affect us, as business from other sources will apparently fully make up for any falling off there may be due to that cause. Approximately 600 of our employés have enlisted, and from time to time we continue to lose a few. No badges are worn by our workmen. In certain of our departments the shortage of skilled labour has affected us to a certain extent, but we cannot say that it has done so materially, taking into consideration the works as a whole. We have experienced difficulty from time to time through shortage of raw materials, but we have now been able to remedy this to a large extent. We have had very little opportunity to follow up new lines of manufacture in view of the fact that since the outbreak of war our works have been continuously overloaded with our normal lines of business.

A firm of switchgear manufacturers states :—

We are switching all our available resources on to war service work. The greater proportion of our eligible men have enlisted, and we expect within the next week or so that the whole of our staff and other employés will be engaged on war service in one form or other.

A firm of engine-makers reports :—

We are devoting ourselves almost exclusively to the manufacture of engines, &c., required by the Government, and, consequently, are not seeking to secure new business either at home or abroad. The shortage of skilled labour materially affects our output, as it prevents us from working night-shift.

A prominent electrical firm in the Provinces, which is very extensively engaged in the supply of munitions of war, but without any hindrance to usual manufacturing and selling operations, reports that it is receiving home and foreign orders freely, and it anticipates that restriction of municipal electrical expenditure will have a considerable effect ; 15 per cent. of the employés have enlisted ; others are going ; no badges are worn. Shortage of skilled labour is serious, and shortage of raw materials also causes difficulty. No progress is being made with new lines of manufacture, but efforts to enter new foreign markets are meeting with very satisfactory results.

Messrs Gent & Co., Ltd., of Leicester, are receiving orders freely for their manufactures from buyers at home and abroad. They do not anticipate that restriction of municipal electrical expenditure will materially affect them. About 15 per cent. of their staff have enlisted, and a fair number are leaving every week. War service badges are worn by their workpeople. The firm suffer a good deal from the shortage of skilled labour. At the present moment considerable difficulty is also caused owing to shortage of raw material, but great efforts are being made to overcome the difficulty. Progress in new lines of manufacture, formerly chiefly Continental, is not as rapid as they would like owing to heavy Government demands upon the works.

Messrs. Veritys, Ltd, of London and Birmingham, have experienced extreme activity in all directions since the commencement of the war. The mere fact that foreign supplies have been cut off, and this country thrown on its own resources, seems to have done untold good, and without going into political or economic questions, it is believed that if, at the end of the war, some tariff wall can be erected against the aggression of the companies abroad, assisted by banks and subsidies as they are, it would be a splendid thing for the electrical industry in this country. It is all very well, during peace time, for agents over here, having small offices and employing only a few clerks, to earn a living by importing against their countrymen large masses of electrical machinery, but in times of crisis, such as the present, the weakness of this policy can be seen. The tendency hitherto has been to turn this country into a large factoring department for foreign firms, whereas the backbone of the Empire is the manufacturing industries which employ Britishers ; industries which are ready to supply requirements in war time, and from which alone can a permanent prosperity be assured. If the Government and municipal authorities will only recognise this and stand by the home manufacturer, there is no reason whatever why the electrical trade should once more fall into the degree of servitude which it had undoubtedly reached when hostilities were commenced.

Mr. George Verity, chairman of the company, has been appointed an Honorary Colonel of the Royal Engineers (T). He is also chairman of Charing Cross Hospital, and has had through his hands over 1,000 wounded soldiers—the care of whom is undertaken without cost to the nation. Messrs. Veritys' works director, Colonel Lister, R.E., has been transferred from the Territorial Forces to the Royal Engineers, and as such, has been in constant employment since mobilisation. He has been over in Flanders, and is at present engaged in raising a further corps of Signal Troops for dispatch to the front. His place has been taken at the works by Mr. T. Pons, long a member of the company, and Col. Verity's work is largely being carried out by Mr. Evans, sales director. Orders are being received fairly freely for the firm's manufactures from both at home and abroad, although foreign trade is naturally somewhat restricted, owing to the financial crisis in South America and elsewhere. The restriction of municipal electrical expenditure has not, so far, affected them, and if, after the war, as stated above, the municipal councils will only see their way to give preference to British manufacturers, as is done in Germany and elsewhere, both for big and small plant and supplies, the effect of the war will be a blessing in disguise.

A large number of the firm's men have enlisted, both at the sales depôts and the works ; their dependents are being looked after by the company. Recruiting from the works has now been stopped by order of the Admiralty, who have given the directors a number of badges to be worn by men engaged on Government work, and who consider that the men remaining are doing their duty as well at the bench as in the trench. Messrs. Verity feel the effect of the shortage of skilled labour, and to some extent the shortage of raw materials, but their men have worked hard and loyally, and have largely made up for the difficulties experienced in other directions.

All the firm's endeavours are being concentrated, during the war, in developing new lines of their manufactures for both at home and abroad. It remains to be seen whether they, like other British manufacturers, are going to be supported.

Swedish Electrical Exports to Canada.—Figures lately issued show that during the last fiscal year, electrical apparatus valued at £185,906 was imported into Canada from Sweden, as compared with only £118,560 in 1913.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

New Ironclad Switchgear.

The Midland Electric Manufacturing Co., Ltd., of Stafford Works, Rea Street South, Birmingham, are now specialising in the manufacture of ironclad switchgear. A number of patterns are being produced, including the Paragon and Camloc ironclad switches, the Memco ironclad change-over switch, the Kantark ironclad fuse, &c.

The Paragon switch has been designed to meet the want for a low-priced totally-enclosed ironclad double or triple-pole switch. The contacts are mounted on a mica insulated bar controlled by a side lever handle, and each pole is mounted on a separate porcelain base. The cover is interlocked with the handle, and the construction allows easy replacement of brushes or contacts; an earthing screw is provided, and the switch complies with H. O. regulations. A Paragon combined switch and fuse unit is also supplied, in which H. O. pattern bridge replacement fuses are contained in the switch case.

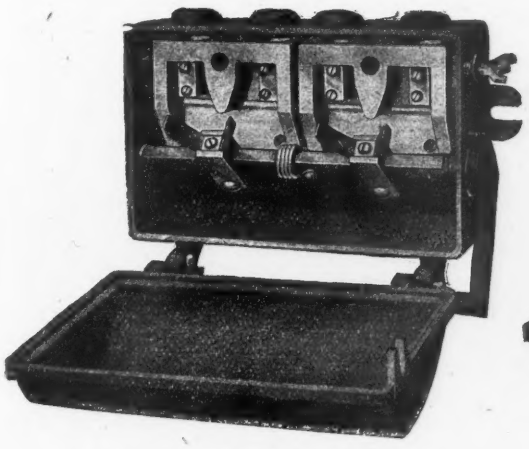

Fig. 1.—Paragon D.P. Switch.

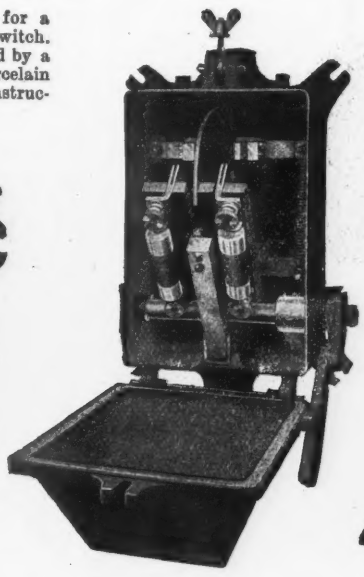

Fig. 2.—Camloc Switch-fuse.

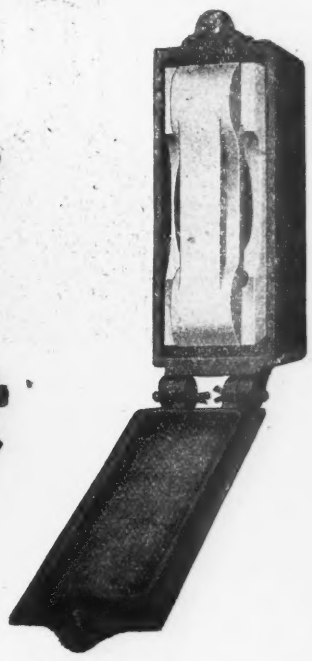

Fig. 3.—Kantark Fuse.

The feature of the Camloc switch is its quick break; it is built on the mica and metal principle, double and triple-pole, with interlocking handle, and the mechanism gives a positive make which is effected independently of the spring. Every switch is guaranteed to withstand 2,300 volts A.C. between contacts and case. This switch is also supplied as a switch-fuse combined with the firm's standard pattern cartridge fuses.

The Memco change-over switch—double and triple-pole—is a completely enclosed ironclad switch suitable for all purposes.

The Kantark ironclad fuse is of the replacement bridge type, of improved design, with contacts well shielded and embedded in porcelain to conform to H. O. regulations. An arc chamber is provided with ventilation slots, to prevent damage to the fuse.

The Paragon and Camloc switches are fully protected, and the design of the Kantark fuse is registered.

Shop Window Reflectors.

Messrs. Simplex Conduits, Ltd., of 116, Charing Cross Road, W.C., have just produced a range of reflectors, designed to illuminate objects displayed in shop windows in the most economical manner. These reflectors throw all the light upon the goods, and prevent the pavement in front of the shop being flooded with light, thus meeting the requirements of scientific illumination, and at the same time falling in with the new lighting regulations. All the reflectors are designed for easy wiring and fixing, and, at the same time, are easily adjustable.

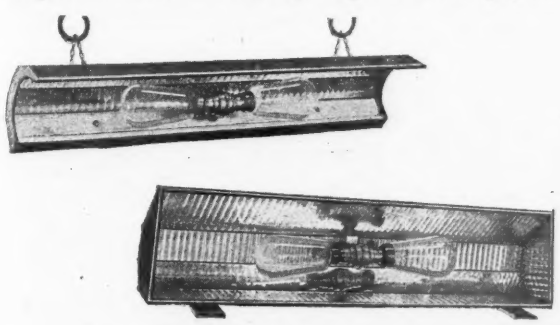

Fig. 4.—Simplex Shop Window Reflectors.

Leaflet No. 583 describes this range fully, and a copy will be sent on application.

B.T.H. Half-watt Fittings.

The new provision department of Messrs. Selfridge & Co., Ltd., has been provided with an exceptionally efficient installation of electric lighting on the most up-to-date lines; the proprietor desired to employ half-watt lamps, and in order to obtain the best possible effect various systems were tried, with the result that the Eye-rest system was adopted. Messrs. Rashleigh Phipps & Co. were the contractors, and the fittings were supplied by the British Thomson-Houston Co., Ltd., of Mazda House, 77, Upper Thames Street, E.C. Fig. 5 shows the indirect lighting fitting as installed in the grocery department, on the first floor; each bowl is fitted with a B.T.H. X-ray reflector, in proper focal position with regard to the filament of the half-watt lamp, which directs the light on to the ceiling. Somewhat similar Eye-rest fittings are used in the provision department, on the ground floor. In the marble market in the basement semi-indirect lighting is employed, with the B.T.H. Lumina fitting, as shown in fig. 6. The intense intrinsic brilliancy of the half-watt lamp is thus shielded from direct vision, while ample ventilation is ensured, and the illumination obtained, it is claimed, is most agreeable—an important feature in shop lighting.

Fig. 5.—Eye-Rest Indirect Fitting.

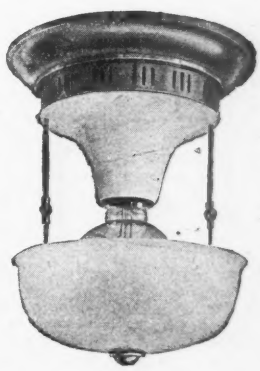

Fig. 6.—Lumina Semi-Indirect Fitting.

B.T.H. Fittings at Selfridge's.

Benjamin Half-Watt Fitting.

The Benjamin Electric, Ltd, of 1A, Rosebery Avenue, E.C., have introduced the new vitreous enamelled steel reflector for half-watt lamps, illustrated in fig. 7. The contour of the

Fig. 7.—Benjamin Half-Watt Fitting.

reflector is such that the filament is hidden from the direct line of vision, the most efficient illumination being produced on the working plane. The skeleton neck ensures ample ventilation, while the Benjamin Goliath holder facilitates wiring and eliminates overheating of the terminals. The fitting is adapted for 300 to 500-watt lamps.

LEGAL.

The Prize Court.—Seizure of Electric Fans.

In the Prize Court on Monday the President, Sir Samuel Evans, gave his reserved judgment in the suit by the Crown asking for the condemnation of five cases of electric fans seized on board the P. and O. steamship *Poona* in London on October 17th last. The goods were claimed by Isaria, Ltd., a company duly incorporated in England.

The President, giving judgment, said: The claimants to the goods seized and claimed in these proceedings (which consisted of five cases of electric fans) are a company named Isaria, Ltd., which was incorporated in May, 1912, and whose registered office at the time of the outbreak of war was 208, Tower Bridge Road, in the County of London. The company carried on business in this country and abroad. The goods (with others) had been sent out to Australia for sale, and were returned to the company in August, 1914. They were seized in the Port of London as prize in the Crown's rights to droits of Admiralty on October 17th, 1914. After investigation of the facts I was satisfied that the goods at the time of seizure belonged to the company. The question which remained for decision was whether, having regard to the constitution of the company, the goods were enemy property subject to seizure. At all material times the number of shares in Isaria, Ltd., issued were 1,250 shares of £1 each. Of these 1,244 were held by Isaria Zahlerwerke, of Munich, a German manufacturing company; one share was held by each of the four directors of Isaria, Ltd., who were German subjects and resident in Germany; one other share was held by one Schoenmann, the secretary of the company, also a German subject; the remaining share was held by one Vallée, who was said to have been a French subject, but who, for some time before the war, had resided at Munich, and been employed by the German company, the Isaria Zahlerwerke. Schoenmann left this country on August 3rd last for Germany, having purported to appoint one of the company's employés, Mr. Frank Morton, to be manager. Mr. Morton represented the company in these proceedings. After the outbreak of war he was informed by the Board of Trade that they were advised that there was no objection to the sale from stock of the company of goods imported from Germany before the war, and that no licence was required for that purpose. Later on (in November last) he was informed by the Comptroller of the Companies' Department of the Board of Trade that as Isaria, Ltd., was a company incorporated in this country, there was nothing (having regard to Sec. 3 of the Trading with the Enemy Proclamation No. 2, dated September 9th) to prevent trading with the company, or the payment to it of money which might be owing to it. So Mr. Morton appears to have carried on the business of the company; and the books and papers of the business have been inspected, when required, by the official accountant appointed by the Board of Trade. For the claimants, it was contended that the goods belonged to an English company, not to alien enemies, and were not subject to seizure or confiscation. On the other hand, it was argued for the Crown that as all the directors were enemy subjects, and resident in Germany, and all the shareholders were also either enemy subjects, or resident in Germany, the goods were in reality the property of alien enemies, and ought to be condemned as such. I was referred to my decision in this Court in "The Roumanian" (1915, Probate, page 26); and, of course, to the judgments pronounced later by the Court of Appeal in "the Continental Tyre Co., Ltd., *v.* Daimler Co., Ltd., and *v.* Thomas Tilling, Ltd." (1915, I.K.B., page 893). I will only observe as to "The Roumanian" that it does not necessarily govern this case. The facts there were different in important and material respects; moreover, I think it will be found that in the course of the arguments in "the Roumanian," counsel for the claimants expressly admitted that the "Europaische Petroleum-Union Gesellschaft mit beschrankter Haftung" was a German company; and the case was dealt with accordingly. The judgments in the Court of Appeal in the Continental Tyre Co. cases, however, bear directly upon the point arising in the present case. What, therefore, ought I to do in this Court in view of those decisions? In matters relating to prize, the Court of Appeal does not bind this Court, for the reason that no appeal lies to the Court of Appeal from judgments given in the Prize Court. The only appellate court in such cases is the Judicial Committee of the Privy Council. If I were of opinion that different principles applied in the present proceedings in a Court of Prize; or if I held a strong opinion upon the legal aspects, even if the same principles were applicable, I conceive it would be my duty to give effect to such opinion even though it differed from that of the Court of Appeal. But I do not think, in the present case, different principles ought to be applied. The matter in controversy appears to me to be one which should be regarded from the point of view of municipal law; and no question of an overriding principle of international law arises. The claimants come forward as a company incorporated in accordance with the law of this country. The claim is not made by the individual shareholders—subjects of a foreign country, enemy or otherwise. The question turns upon the status of the company in this Kingdom. Accordingly, nothing in this case depends upon the bearing of the law of nations upon our municipal law. In these circumstances, I think it more respectful to the Court of Appeal to act in accordance with their judgment, however much I might feel inclined to sympathise with the dissentient views of Lord Justice Buckley. In the special facts of this case and of the Continental Tyre Co. cases, a decision in accordance with Lord Justice Buckley's judgment might be easy; but it is fairly obvious that with even a slight variation of facts as to the holding of the shares, the adoption of a definite general principle as a foundation for his judgment and its application would give rise to great difficulties. Without dealing with it any further, I may observe that even in Lord Justice Buckley's dissenting judgment this passage is to be found:—"The corporation, if it be a British corporation, stands in the same position for most purposes as a British subject. For instance, as regards rights of ownership of property and the right to protection and assistance by the law. But while it stands for most purposes in the position of a British subject, it cannot be correctly described as a British subject." The question before me deals with "rights of ownership." For the reasons stated, I am content to accept respectfully the law as laid down by the Court of Appeal, and must leave the ultimate decision to a higher tribunal. If the judgment of the majority of the Court of Appeal is unsound, it must be so pronounced by the House of Lords on appeal from them; or by the Privy Council on appeal from this Court. If it is affirmed as good law, but is considered to require alteration as a matter of just policy, then the Legislature must act. I desire to add one word by way of reservation. The case of the ownership of vessels registered in this country is so special, having regard to our merchant shipping legislation, that I venture to repeat what I said in "The Tommi" and "The Rothersand" (1914, Probate, page 251), and to reserve expressly all questions which might arise if it were contended that a British vessel was the property of a company constituted like that of Isaria, Ltd. The judgment of the Court is that the goods seized are not enemy property, and I order their release. On their release they will be delivered over to Mr. Morton, the present manager of Isaria, Ltd.; and he, of course, will deal with them as belonging to the English company; and he will not be able to deliver them or their proceeds over to the alien enemy shareholders of the company or to use them or to apply their proceeds for the benefit of any such shareholders during the existence of the war.

Patent Revocation.

On the 29th ult. the Court of Appeal, composed of the Master of the Rolls, Lord Justice Phillimore and Mr. Justice Joyce, delivered judgment upon the appeal of Witcarborizing, Ltd., from a judgment of Mr. Justice (now Lord Justice) Warrington dismissing their petition for revocation of letters patent No. 10,370 of 1912, granted to John E. Jameson, Oliver H. Valpy and Edmund A. Buckle, for "Improvements in the treatment of peat and the like." One of the claims of the patent was as follows:—"In a process for the extraction of water from peat and like substances passing an electric current through a pulp of the same heated to a temperature of 100° C. under a pressure such that no steam is produced substantially as described." Appellants applied for revocation of the patent on the grounds that it was invalid for want of utility and insufficiency of directions. It was proved that the water in peat was partly free and partly combined in the form of "hydro-cellulose," and that the combined water could not be got rid of by pressure as the free water could. Prior to the patent it had been suggested that the water could be removed by the use of a comparatively high temperature and pressure. The patentees (the respondents) alleged that the result could be attained by the use of an electric current, the voltage of which might vary within wide limits, at a lower temperature, but the petitioners contended that the only result obtained by the use of the current was due to its heating

effect. Mr. Justice Warrington held that the specification described a process in which the electric current was used to effect the decomposition of the "hydro-cellulose" without recourse for that purpose to heat, while the earlier process depended on the effect of heat alone; that the process was useful; and that the directions were not insufficient. He accordingly dismissed the petition with costs, and granted respondents a certificate of validity. From this decision the petitioners now appealed.

Mr. Walter, K.C., Mr. Colefax, K.C., and Mr. Frost appeared in support of the appeal, and Mr. Bousfield, K.C., and Mr. J. Hunter Gray for the respondents.

THE MASTER OF THE ROLLS, in the course of his judgment, said he did not consider the experiments which had been made by both sides were either satisfactory or conclusive, but, on the whole, he thought the petitioners had failed to prove that the respondents' patent was bad for want of utility. While feeling more difficulty upon the other point as to the directions in the respondents' specification being insufficient, as alleged by the petitioners, he was not, on the whole, prepared to differ from the conclusion arrived at by Mr. Justice Warrington upon that issue. The result was that in his opinion the appeal failed and should be dismissed with costs.

LORD JUSTICE PHILLIMORE and MR. JUSTICE JOYCE delivered judgments to the same effect.

PIGGOTT & CO., LTD., *v.* HICKS & CO.

ON Friday, before his Honour Sir W. Lucius Selfe, in the Marylebone County Court, Messrs. Thos. Piggott & Co., Ltd., engineers, Atlas Works, Springhill, Birmingham, claimed the return of £13, paid for an electric motor to Messrs. Hicks & Co., engineers, Portsdown Road, Maida Vale, W.

MR. RANKIN, counsel for the plaintiffs, explained that in February the defendants advertised a second-hand electric motor, as good as new, of 7½ H.P., and the plaintiffs purchased it, paying a cheque for the amount in advance. When the machine arrived at Birmingham it was found that the coils had been fused up and that the motor was nothing like 7½ H.P. A new motor would have cost about £25, but at that date it would have taken a month to deliver it. In these circumstances, cash was paid for this motor. Counsel said that his clients had sustained considerable damage through want of this motor and having to substitute another. It cost in labour alone £7 to move one of their motors from one part of their works and install it where the additional power was needed. But for the fact that they had a spare motor, the damage would have been much heavier.

MR. DYSON, manager of the plaintiffs' works, said that the motor was delivered on March 2nd. It was urgently wanted to complete a contract for steam pipes for the Admiralty, and the one supplied by the defendants not being what it was represented to be, caused delay in the work. It was wanted to drive a lathe. When it was discovered that the coils of the motor were defective and that the horse-power was much under 7½, they had to dismantle one of their fixed motors and place it to complete the pipe contract. The out-of-pocket cost of this work was £7 5s., and the work was delayed four weeks.

His HONOUR: Thus you have lost more than £7?—WITNESS: Considerably.

His HONOUR: There will be judgment for the plaintiffs for £26 9s. and costs, payable in 14 days. And about the rejected motor?

COUNSEL: It lies with my clients at the defendants' risk.

WORKMEN'S COMPENSATION.

AT Preston County Court last week, Luke Riley, labourer, 21, Pollard Street, brought an unsuccessful claim under the Workmen's Compensation Act against the United Electric Car Co., Ltd., of Strand Road, Preston. It appeared that three years ago an accident occurred to the applicant, and his leg was injured. The respondents admitted liability for payment of compensation in respect of that accident until November 3rd last, when it was contended that applicant had fully recovered and was able to do the work they offered him. Applicant declared that ulcers on his leg rendered him unfit for work.

JUDGE STURGES gave judgment for the respondents, holding that the ulcers had no connection with the accident. Applicant was awarded costs up to the time of the payment into Court by respondents, and the latter were awarded subsequent costs.

PARLIAMENTARY.

Aberdare Tramways.

AFTER several days' sitting the Select Committee of the House of Lords, presided over by Lord Newton, has passed the Aberdare U.D.C. Bill. The objects of the Bill are the construction of certain tramways, the provision of railless traction and motor-'bus routes, and certain street improvements. The principal opponents were the Great Western Railway Co. and the Taff Valley Railway Co.

MR. CLODE, for the promoters, said that the tramways of the Urban District Council, which were opened in 1913, had done fairly well, but the railless traction routes had not shown a profit. The tramway extensions proposed were from Trecynon to Hirwain, from Aberaman to Cwmaman, and to Aberowmboi. It was proposed to extend the existing railless traction routes from Abernant Road to Cwmbach and from Trecynon to Cwmbach. Sanction was asked to borrow £49,751 for the construction and equipment of the tramways and railless cars, and £8,500 for motor-'buses.

A great deal of local evidence was called, and MR. S. SELLON and MR. J. B. HAMILTON also gave evidence in support of the proposals.

MR. BALFOUR BROWNE, K.C., for the Taff Vale Railway Co., in asking the Committee to reject the Bill, contended that Parliament never intended tramways to run alongside existing railways to take traffic from them.

MR. LLOYD, K.C., on behalf of the Great Western Railway Co., agreed that the proposed tramways were unnecessary and would be unremunerative.

The Committee passed the preamble except with regard to the proposed extension from Trecynon to Hirwain, which was struck out.

Yorkshire Electric Power Bill.

THE Bill promoted by the Yorkshire Electric Power Co. came before the Select Committee of the House of Lords, presided over by Lord Hylton, on April 27th and subsequent days. The company, under the Bill, sought for power to supply electric current for lighting, and also provided for the division of the capital into £1 shares.

MR. FREEMAN, K.C., appeared for the promoters, and said the area of the company comprised the greater part of the West Riding of Yorkshire, but the powers of the company only allowed them to supply electric power in bulk. The authorised capital of the company was £2,000,000, and £538,000 had been expended on capital account. In no fewer than 84 districts in the area there was no body authorised to supply electric light. The opponents of the Bill mainly consisted of county boroughs, and he contended that as the company could not go inside the areas of these boroughs, they were not affected.

After hearing evidence, the Committee struck out the main clauses of the Bill, and in consequence the promoters withdrew the whole Bill.

Second Readings.—In the House of Lords, on May 4th, the Metropolitan District Railway Bill and the Ascot District Gas and Electricity Bill, were read a second time.

OUR LEGAL QUERY COLUMN.

"SWITCH" writes:—"We should like the help of your Legal Column with regard to a question of trading with the enemy. The matter is probably one in which several readers find themselves, and we think is, therefore, of general interest. Should you mention the matter in your paper, we must ask you, for obvious reasons, not to mention our name in any way. The position is that in the past we had various apparatus made for us in Germany; the actual orders were placed with the agent of the German firm in this country, who is either an Englishman or a neutral. The orders were made out to him; the invoices we received were on the German manufacturers' paper, with a note on the bottom: 'Payable to our agent, Mr. . . . . in London.' The cheques were paid by us to this agent. Since the outbreak of war we have made arrangements to have the apparatus made in this country, and for various reasons have had to place contracts for some time ahead. We wish to know how we can take steps to have the remainder of the outstanding orders with the German manufacturers legally cancelled. We might say that the orders given to the agent in London mentioned a definite number of pieces but generally stated 'Delivery as required.' Thanking you in anticipation for any assistance you can give us."

*** An executory contract concluded with an alien enemy before the outbreak of war is merely suspended during the war as regards the right to performance and the right of action. But such a contract is either avoided or dissolved by the outbreak of war (1) if it enures to the aid of the enemy, or (2) if it is in its nature incapable of suspension. A contract will in its nature be incapable of suspension if (*inter alia*) its proper performance necessitates intercourse with the enemy during the war. The above are the principles of law (apart from the law as defined by various proclamations) which govern the question propounded. It would seem that if any payment made to the English agent were to have been by him transmitted to his German principals, it would be illegal. By the Trading with the Enemy Proclamation (No. 2), Art. 5, any person resident, carrying on business, or being in the British Dominions is warned—(1) Not to pay any sum of money to or for the benefit of an enemy. It is true that if an enemy has an agent in this country duly appointed before the war, payment to such agent is not a crime, although the money must not be transmitted by him to his principal (see Kershaw *v.* Kelsey (1868) 100 Mass. 561). In these circumstances inasmuch as our correspondent will probably have no means of knowing whether money is being transmitted to Germany or not, to continue to trade with the agent will be a very dangerous proceeding, and it is difficult to understand why he need take steps to have the orders legally cancelled. All that is necessary for him is to serve a notice saying that he does not propose to accept any more goods under the contract. He would do well, however, to consult a solicitor.

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CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Engineering Industry and the War.

Many will read with great interest your valuable article entitled "The Engineering Industry and the War," and I should like the favour of a portion of your space to make a few remarks thereon.

I believe that zeal without knowledge is frenzy, and I believe that the basis of the genius of our high national civilisation exists in the preventative, constructive and aggressive resources of which our professional engineers are the masters and national custodians.

I have asked a friend to put down a question in Parliament upon this subject, because I find, upon discussing the matter with a number of Members of Parliament, and in other obvious patent ways, that the nation knows little or nothing of the vital asset represented by some 12,000 professional engineers appearing in the published lists of the Institutions of Civil, Electrical, and Mechanical Engineers.

I know the medical profession in many countries, and having met them in consultations, can testify in many ways that they have little or no knowledge of the important subject of the industrial performance capacity of male or female individuals. Try any medical man you like, and he does not know that the average female heart pumps blood as 3 is to 5 of the average male; it seems incredible, but they do not know this simple fact in their line, and yet the blood pumped by the heart is the measure of industrial performance.

In the area of the sacrum it is the same, and these are the biological laws governing weight-lifting and carrying capacity as well as reserve power for overtime and special sustained mental or physical efforts.

Engineers are the only professional men who graduate in actual labour experience and know how to get those results from individual output which are so essentially a part of the uniform national effort in every part just now, without the absurd long hours and overstrain which are doing great general injury unnecessarily.

In a letter it is impossible to do justice to the capacity and responsibility of the trained engineer, but we have, whatever one may say, to thank Parliament for the information given last week, that the Admiralty retains eight medical men at £5,000 per annum.

But where are the engineers? How many engineers are retained by the whole Empire at £5,000 per annum? Germany is fighting us with engineers, not with doctors. The greatest preventative and aggressive *medicine* is engineering, not physics and surgery, and the great Dr. Erlich has lowered himself when he declares "this is a doctors' war."

If the Germans will withdraw their engineers out of the war we will withdraw our doctors, and in that case in three weeks we should be in Berlin.

One is glad to see professional men retained at £5,000 a year, which a good man is honestly worth to sustain the burden of his position. But, may we not see, since war always has been an engineering job, our prominent engineers placed in prominent positions and paid like doctors and lawyers in the interests of the State? Why have we an Engineering Committee on the production of munitions of war presided over by a lawyer, and no professional engineer listed by the great British engineering institutions, not one, upon that Committee?

J. Sutherland Warner, A.M.I.Mech.E.

London, W., *April 30th*, 1915.

Mathematical Notation.

With reference to my proposal which you published in last week's issue, I had sent to Prof. A. E. Kennelly, of Harvard University, a fore copy of the same, and in an appreciative answer, he thinks the suggestion a very good one, and "hopes it will be earnestly advanced with a view of winning its ultimate adoption." This though, he says, he believes he was the first to introduce, about 1893, the self explanatory form of notation $r/\underline{\theta}$; but I deem it would not take long for any interested in the subject to accept the dagger with its simple *memoria technica* for positive and negative angles.

F. Jacob.

London, S.E., *May 3rd*, 1915.

Batteries for Submarines.—Hitherto, we learn from American sources, only lead batteries have been used on board submarines. It is reported, however, that an Edison nickel-iron battery is to be installed in a U.S. submarine which is now under construction.

British Industries Fair.—Buyers who have not received invitation cards for this Fair, which opens on May 10th, at the Agricultural Hall, Islington, should communicate at once with the Board of Trade at 32, Cheapside, E.C.

WAR ITEMS.

Municipal Employés and the Manufacture of Munitions.—A census of municipal electricity and tramways employés who can be spared for the making of war munitions has just been taken in Bolton, Wigan, Bury, Salford and other areas of central and south-east Lancashire. It is understood that a considerable number of such employés are available. The Northampton Tramways Committee has reported to the Town Council that if a 10 minutes' service is adopted, 43 men could be released in order that they may be engaged in the manufacture of war munitions. The most suitable men are to be selected by the Committee. The Lighting Committee of the Leyton District Council has approved a scheme whereby the mechanics at the works will be enabled, in their own time, to assist in the manufacture of spare parts for transport motors for war purposes, the material being supplied by the Associated Equipment Co., who will pay the men for work done.

After the War.—The Fulham Electricity Committee recommends that the Council undertakes that, when engaging new hands after the war, preference shall, as far as possible, be given to those who have served their country under arms or in making munitions of war.

War Bonus.—In view of the greatly increased prices of household necessities caused by the war, Messrs. J. & W. B. Smith have decided, quite voluntarily, to pay from April 24th a special war bonus to all their employés for the duration of the war.

Siemens's Employés with the Forces.—We have received a copy of a booklet of 46 pp., issued in April, giving the names of employés of the Siemens Companies who are now serving in H.M. Forces. These are set out alphabetically, with particulars of the department in which employed (offices, branches or works), and the unit and rank now held. Copies of the booklet are being distributed among all the men—who now number well over 1,000. Still more have enlisted since the booklet was printed.

Blackpool Electrical Employés.—Of the men who were recently engaged in the Blackpool Corporation electricity department, 31 are on military service and six are engaged in the making of munitions. The tramways department has a staff of 190 men. There are only seven single men in the office and engineering departments, and four have dependents. On the traffic side there are eleven single men of military age, but eight have been pronounced medically unfit for service, and two of the remaining three have dependents. There are 49 tramway employés serving in the Forces.

Board of Trade Assistance.—The Board of Trade Commercial Intelligence Branch has issued list No. 18 of inquiries received during the week ending April 24th for names of suppliers of goods.

Government Cable Contracts.—Replying in the Parliamentary papers to Mr. Booth, Mr. Beck, as representing the First Commissioner of Works, said that his department had recently given a contract to the Union Cable Co., Ltd. The principal holding was in German hands, and while the managing director, Mr. Blackwood, was an Englishman, the other four directors were German. The works were at Essex and a number of English people were employed, and not a penny of profit of any kind went to the German people. The action of the Office of Works in the matter was in accordance with the policy laid down for them, in common with other departments, by the Government in the Trading with the Enemy Act.

The Position in Brussels.—M. E. Janssens, writing from 24, Budge Row, E.C., gives the following report of the situation of the electrical trade in Brussels, which has been handed to him by a neutral subject who has just returned from that town:—"All things are very quiet. The tramway companies are running a few cars on each of their services; this, with the consent of the German authorities, who have taxed their receipts heavily. A number of factories are considering—now that no orders are in hand—the manufacture of a lot of articles quite out of their lines, thus increasing their output to a maximum. 'Energie and Lumiére' employ actually 15 per cent. of their personnel to make new types of electrical apparatus, and although engaged solely in that line before the war, have now started, as a side line, the manufacture of sanitary appliances! The Belgian manufacturers are busy in studying new devices, in improving the existing types on the market, and in increasing the output of their works, while their representatives are in England searching for sound connections."

Newcastle Electrical Manufacturers and War Munitions.—At a special meeting of the electrical section of the Newcastle-on-Tyne Chamber of Commerce, held on Friday last, to take into consideration the question of expediting the production of munitions of war, it was unanimously resolved that the members of the section should offer their individual help in their spare time to the Munitions of War Committee in any capacity. It was further agreed that all firms represented in the electrical section should state to the Munitions of War Committee what special work they were able and willing to do for the Admiralty or War Office. The opinion of the Committee is also to be sought as to whether the

section should approach similar bodies and ask for promises of individual help, should it be required.

Kieff Electrical War Tax.—The Governor of Kieff has notified the Electrical Company of the town that the local Duma has decided to levy a war tax of 5 per cent. on the sums paid for electric light, and asks the company to recover from the users. On the request from the company for instructions how to act in the event of the subscribers refusing to pay the tax, the Governor has admitted its inability to sue, and it has to refer cases of recalcitrancy to the town authorities.

Russia: Catalogues Wanted.—Catalogues and price lists are wanted by Bracia Borkowscy, electrotechnical depôt, Warsaw, Al. Jerozolimska 56.

Russia.—Several agents in Warsaw are anxious to secure representation there for British manufacturers of electrical goods and fittings and high-voltage goods. Application should be made to the Board of Trade Commercial Intelligence Branch in London.

German Exports to U.S.A.—The President of the Board of Trade states (says the "Times") that the imports into the United States from Germany were valued at £12,222,000 in the seven months ended February, a decrease of 48 per cent. Imports from the United Kingdom, however, were valued at £29,824,000, as compared with £34,413,000 in the earlier period, a decrease of only 13 per cent. Imports from Germany, though higher in January, 1915, than in preceding months, owing mainly to large imports of dye stuff and fine chemicals, were lower than in the corresponding month of 1914, and showed a heavy decline in February.

Engineers' War Wages.—The Amalgamated Engineers in Ashton-under-Lyne, Stalybridge, Dukinfield and Hyde have had their wages advanced 3s. per week on time rates and 7½ per cent. on piece rates, to be recognised as war wages, and as due to and dependent upon the existence of the abnormal conditions now prevailing in consequence of the war.—"Financial Times."

The Future of British Engineering Trade.—In the course of an editorial on "War Engineering Organisation and Future Trade," the "Engineer" writes:—That an idea of utilising the present war organisation for peace requirements is taking root in the minds of manufacturers may be gathered from the suggestion put forward by Mr. Arthur Balfour at a recent meeting of the British Foundrymen's Association at Sheffield. Mr. Balfour, who is a well-known Sheffield manufacturer, is clearly one of those who recognise that an opportunity has arisen for shaping the destinies of the British engineering industry, and for striking out on new lines. If his advice be followed, then the war, however heavy the price to be paid, will not have been wholly valueless. The opinion is put forward that Sheffield firms, and the criticism applies with equal force to other centres of production, are at present handicapped in their organisation by having too many articles to make in a single works, and it is recommended that the existing close co-operation between different works should be continued after the war, and that groups of manufacturers should work together, the production of different commodities being allocated by arrangement among the various establishments. Such a proposal is not, of course, entirely novel, but it ought to make a special appeal at this juncture, when the future of British engineering is to a certain extent in the melting-pot, and the industry will shortly be face to face with new conditions. There can be no question that when Germany realises that her attempt to dominate the world by force of arms has resulted in failure, she will seek by a fresh and more aggressive campaign than in the past to retrieve her fallen fortunes in the commercial arena. She will, however, start under material disadvantages, for by her conduct of the war she has antagonised the whole world and squandered the goodwill in overseas markets created by years of patient effort. It will be a long time before her manufacturers can hope to live down the obloquy her soldiers have brought upon themselves in the field. The interregnum in German commerce thus created should be the opportunity of a home industry, which, without any slavish imitation of German methods, should by then possess many of the advantages of scientific organisation, and be prepared for the adaptation of the new machinery of commerce to the needs of consumers."

No War Bonuses for Single Men.—A special joint committee of the Stoke-on-Trent Federated Council recommended that a war bonus of 2s. a week be paid to all employés of the Corporation receiving 30s. a week or less, and 1s. to employés receiving between 30s. and 40s., the recommendation not applying to employés under 21 years of age. When the matter was before the Stoke-on-Trent Council last week, an amendment was put that the bonus should not be given to unmarried men eligible for military service, but this was lost, it being stated that many single men were compelled to remain at their work with the Corporation and others had mothers to support. Another amendment was moved that all single men be excluded from bonus benefits, but eventually it was resolved that the bonus should not be given to single men except in cases where they were the sole support of one or both parents.

Labour at War Factories.—The following new regulation has been added under the Defence of the Realm Act in relation to labour employed at works where war munitions are manufactured:—"8b. The occupier of a factory or workshop the business carried on in which consists wholly or mainly in engineering, shipbuilding, or the production of arms, ammunition or explosives, or of substances required for the production thereof, shall not, nor shall any person on behalf of the occupier of such factory or workshop, either directly or indirectly, by canvassing, advertisement or otherwise, take any steps with a view to inducing—(a) any person employed in any other factory or workshop, being a person engaged on work for any Government Department or otherwise serving war purposes, to leave his employment; or (b) any person resident in the United Kingdom at a distance of more than ten miles from the occupier's factory or workshop, to accept employment therein, otherwise than by notifying vacancies to a Board of Trade Labour Exchange; and in the event of any person contravening the provisions of this regulation he shall be guilty of an offence against these regulations."

Switchboard Service in Wartime.—We are informed that many men have already been enrolled as full-time or part-time switchboard attendants to release younger men for service in the Army. Electrical engineers willing to assist for half-night shifts on alternate nights are wanted in the following districts:—Hammersmith, Wandsworth, Tooting, Streatham, Clapham, Stockwell, Battersea, Camberwell, Holborn, Camden Town, Islington, Mildmay Park, Clapton, Hackney, Limehouse, Barking, Poplar, Woolwich, Lewisham, and Forest Hill. Further particulars can be obtained at the offices of "Electrical Engineering."

Roll of Honour.—Private Whiteside, of the 5th King's Own Royal Lancaster Regiment, who has been killed at the front, was formerly employed at the Lancaster Electricity Works.

Private Alfred Jones, aged 34 years, of Crewe, who has died at the Cambridge Military Hospital from meningitis, served for a time at the Salford Electrical Engineering Works, under Mr. Donal Fraser. More recently he had been an assistant examiner in the Patent Office.

We regret to learn that Second Lieutenant John Chamberlain, of the South Wales Borderers, is reported wounded. Lieut. Chamberlain is well known to many of our readers by reason of his connection with Messrs. Chamberlain and Hookham, Tubes, Ltd., and various other businesses. We are glad to be able to state that up to the time of writing he is making favourable progress.

Engineering readers will, we are sure, join us in expressing sympathy with Professor Archibald Barr, of Glasgow, whose second son, Lieut. J. Y. Barr (B.A., Oxford) was killed in action on April 25th at the age of 23 years.

Private J. Burns, formerly employed by the St. Helens Cable Co., has been at the Base Camp, Havre, for some considerable time, suffering from a frost-bitten and septic foot.

Personal.—Last Tuesday's "London Gazette" contained the following appointment:—Territorial Force—No. 4 Electric Lights Company, Devonshire (Fortress) Engineers: George Owen Tipping to be Second Lieutenant. May 5th.

BUSINESS NOTES.

Book Notices.—*Model Power Boats.* By E. W. Hobbs. London: Percival Marshall & Co. Price 5s. net.—So far as we are aware, this volume is unique in scope, and certainly its excellence entitles it to become the standard treatise on a subject which is as important from the scientific and technical standpoint as from its social and sporting interest. The building of model boats of every description and the determination of their excellence of design by speed trials constitutes a useful method of naval architecture and research.

This the author clearly recognises, and emphasises it by devoting great attention to the naval architecture of small craft, and the treatment he gives to the subject is such that those who wish to build and run their vessels on thoroughly scientific lines will find all the necessary information herein. Those who do not feel disposed to take their sport so seriously will yet find the "theoretical" sections of the book helpful in explaining facts which could only be learned otherwise by costly experience, while the exclusively practical chapters will be of interest to every reader engaged in model boat work or contemplating its performance—whether professionally or as a hobby. After a brief historical survey of model power boating and a review of the sporting and social aspects of the pastime, the author illustrates and describes over 30 different classes of models and explains the merits of each. Chapter III, explaining how and why a boat floats upright and how this result may be secured, should save many painful experiences of certain phases of application of Archimedes' principle. The next chapter deals with resistance and propulsion in sufficient detail to enable the reader to design his boat on rational lines, the precise steps to be taken being set out in the next chapter. Alternative methods of hull construction are then discussed; the reader is left free to adopt whatever type and size of vessel he desires, and is given all the information necessary to enable him to carry his ideas to a successful issue. The next five chapters deal with the power equipment of the vessel. The general construction, method of working, merits and selection of steam engines, boilers, burners, petrol engines and

electric motors are described and liberally illustrated. It is interesting to note that small steam engines are rated by watts, and this convenient power unit is adopted in many other parts of the book. The treatment of electric motors for propelling purposes is very elementary, but possibly sufficient; the possibilities of nickel accumulators should surely be mentioned. Deck fittings and the fitting-out of models, on which appearance and success so much depend, form the subjects of two chapters, and the work is terminated by an excellent chapter on power boat racing and a glossary of technical terms.

Improved Four-Figure Logarithm Table. By G. C. McLaren London: Cambridge University Press. Price 1s. 6d. net.—The arrangement of the tables in this work is excellent; with the aid of a thumb-index, and well-chosen spacing of the lines, the log of any number can be found in a few seconds. The printing and paper are equally satisfactory. Difference columns, which form an essential feature of some so-called "four-figure" tables, and which are an unmitigated nuisance in use, are here dispensed with, three figures being in the first column and the fourth at the top of the page. The author has introduced an improvement to surmount the difficulty due to approximation in the fourth figure; the log of 5024, for instance, to six places is 701050; in a four-figure table, shall it be entered as 7010 or 7011? The author writes 7010. in this case, and for the log of 5023 (700963) he writes 7009 :, the single dot representing "about one-third" and the double dot "about two-thirds," and being taken into account accordingly in the use of the tables. He claims that this reduces the possible error in the fourth figure from 5 to 1, as compared with ordinary four-figure tables.

This may be true; time does not permit of our working out the large number of examples necessary to verify the statement, but it is clear that a closer approximation can be obtained in this way. Another innovation seems to us somewhat risky. In order to facilitate the use of logs by those whose mathematical knowledge is of the scantiest, Mr. McLaren dispenses almost entirely with the use of the index, and works only with the mantissa, the position of the decimal point being found by inspection. Up to a point this is quite feasible, but it limits the range of operations to multiplication and division—the user would be at sea in finding the root of a fraction, and even in multiplying or dividing decimal fractions it is easy to fall into error.

Reid's Handy Colliery Guide. Newcastle-on-Tyne: Andrew Reid & Co., Ltd. Price 2s. 6d.—This is a new edition of a guide and directory to the coal industries of the North of England (Northumberland, Durham and Yorkshire). It contains a map showing the collieries, railways and stations in these three counties, also a copy of the Coal Mines Act, 1911, with various statutory rules and orders issued since that Act came into force. The collieries are particularised, in tabular form, as to company, colliery, situation and station, agent, manager, and engineer, and in other sections alphabetical lists appear of agents, managers, and fitters. The special rules relating to the use of electricity in mines are given in full. Some pages of miscellaneous information, formulæ, &c., by T. R. Blackett, occupy the closing pages.

"*Journal* of the Institution of Electrical Engineers." Vol. LIII, No. 247. May 1st, 1915. Price 3s. 6d.—This issue contains papers on "The Power Supply of the Central Mining-Rand Mines Group," by J. H. Rider, and "Methods of Testing the Scherbius Compensator," by A. A. Ahmed.

"*Bulletin* de la Société Internationale des Electriciens." Vol. V, No. 41. April, 1915. Paris: Gauthier-Villars. Price 3 fr.

"*Journal of the Tramways and Light Railways Association.*" London: Caxton House.—The April number contains a full report of the House of Lords' Judgment in the case of The L.C.C. *v.* Islington Assessment Committee.

"The Year-Book of Wireless Telegraphy and Telephony." 1915. London: The Wireless Press, Ltd. Price 3s. 6d. net.

Messrs. William Hodge & Co. announce the early publication of a Supplement to "The Law of Contract during War," by Prof. W. F. Trotter, bringing the law up-to-date.

A Minister of Commerce.—At the annual meeting of the Association of Trade Protection Societies of the United Kingdom, which is to take place in London on Tuesday and Wednesday next, several resolutions will be submitted, agitating either for a Minister of Commerce, or for a special Government department charged with trade, industry and commerce only. It is proposed to forward to the Prime Minister and the President of the Board of Trade the expressed hope of the Association that even while the war is proceeding such a department may be organised. The Association asks that a Minister of Commerce shall be appointed to maintain relations with British Consuls abroad, with a view to increasing the export of British manufactures, and that British Consuls in all important countries should be British subjects, with instructions to make frequent reports on trading requirements to the said Minister.

American Foreign Trade.—Reuter's agent in Washington states (according to the *Financial Times*) that commercial experts in New York and Washington are at present deeply engrossed in the question of the possibility of domestic manufacturers forming combinations of selling agencies abroad for the promotion of foreign trade. It is believed that such a selling agency plan, a detailed arrangement of which has recently been drawn up and recommended by the Advisory Committee of the United States Chamber of Commerce, is indispensable to the growth of American commerce on an international basis.

Private Arrangements.—Allen & Grosse, Ltd., electrical engineers, Queen Street, Belfast.—A meeting of the creditors was held on April 27th, in Belfast, when a statement of affairs was submitted, showing liabilities £1,763, and assets estimated to produce £712. After allowing £25 for the claims of preferential creditors, the net assets amounted to £687, an apparent deficiency being disclosed of £1,077. It was reported that the company was formed about three and a half years ago, but had only traded with success during the first 12 months, and for the past two and a half years it had been working at a serious loss. A lengthy discussion ensued, and no resolution was passed, but it was suggested and arranged that three of the creditors present should look into the assets and report to an adjourned meeting. The following are creditors:—

Albion Electric Stores	£14	Newtons, Ltd.	£29
Brotherton Tubes & Conduits, Ltd.	33	Pritchetts & Gold, Ltd.	135
W. T. Glover & Co., Ltd.	94	Veritys, Ltd.	38
N. C. C. Electrical Co.	30	Fielding & Platt, Ltd.	149

Fardon & Carpenter, Ltd., electrical engineers, 4, Maidenhead Court, London, E.C.—The following are among the creditors herein:—

Lydall & Son	£15	Pfeil & Co.	£19
Allan Bros.	17	Rollett, H., & Co.	23
Elika Brgmlampa, Nuremberg	18	Sterling Telephone Co.	12
Grevener, J. and H.	22	Schwafe, F., & Co.	30
General Accessories Co., Ltd.	13	Directors' fees	154
Grothe Sohn, A.	22	Solicitors' costs	29
Oldham & Willy	34	Rent	16
Holloway Foundry	17	Electric light	19
Odhams, J., and G.	23	Salaries	13

Electrical Wholesalers' Federation.—An interesting registration notice appears in our "New Companies Registered" section to-day. The Electrical Wholesalers' Federation, Ltd., has been formed for a number of purposes there set forth, with offices at Amberley House, Norfolk Street, Strand, W.C. The number of members is declared not to exceed 100, but the Committee may register an increase. The subscribers who constitute the provisional Committee are:—Messrs. M. Beales, F. Pooley, R. W. Smith, F. S. Smith, and A. G. Beaver, all of London; P. L. Davies, of Liverpool; and G. O. Donovan, of Birmingham.

Bankruptcy Proceedings.—G. Burgess (Granville Burgess & Co.), electrical engineer, 27, Museum Chambers, Bury Street, W.C.—A first and final dividend of 11½d. in the £ is payable on May 7th, at Bankruptcy Buildings, W.C.

Patent Restoration.—An order has been made for the restoration of Patent No. 26,034 of 1909, for "Improvements in means for imparting stability to unstable bodies," granted to Louis Brennan.

Cheltenham Electricity Department.—The address of this department is now:—Municipal Offices, Promenade, Cheltenham. The telephone number of the offices will be 1001, and for the works, as before, 106.

Catalogues and Lists.—The Langdon-Davies Motor Co., Ltd., of 110, Cannon Street, London, E.C., has issued a handy pocket memoranda book, containing insurance coupon, and a number of useful tables. Standard sizes and types of the firm's motors are particularised also in tabular form.

"K. & W." Soap Fountain Co., 8, Bream's Buildings, London, E.C.—Particulars of their liquid soap fountains, which are used in many workshops with economical results—the soap cannot be left in the water or stolen.

Cameron Sales Organisation, 9-10, Southampton Street, London, W.C.—Eight-page illustrated and descriptive price list of "White Cross" electric vibrators.

Messrs. Benjamin Electric, Ltd., 1A, Rosebery Avenue, London, E.C.—Illustrated leaflet describing a new Benjamin half-watt reflector for lamps up to 500 watts. The company announces an advance of 10 per cent. in the prices appearing in this circular, also in those appearing in their L5 catalogue (excepting Section 4).

Messrs. E. S. Hindley & Sons, Bourton, Dorset.—Illustrated leaflet describing their vertical oil engines for electric lighting, and their two-crank compound enclosed steam engine.

Messrs. Fielding & Platt, Ltd., Gloucester.—Eight-page illustrated pamphlet describing the Fielding semi-Diesel crude oil engine. The firm makes engines ranging from 11 B.H.P. to 300 B.H.P.

Messrs. Donovan & Co., 47, Cornwall Street, Birmingham.—Eight-page pamphlet, setting out prices of a large variety of electrical accessories, fittings, bells, batteries, cables, starters, &c.

L.C.C. Contract Prices.—This week's agenda of the L.C.C. contains the following:—"Regulation No. 662 provides that, in cases in which the publication of the estimated value of a contract for stores, &c., may lead to the disclosure of the individual price or prices quoted, the particulars, instead of being included in the report of the Stores and Contracts Committee, shall be laid on the table for the information of members. The considerations which led the Council to make this regulation appear to apply equally to the stores, &c., purchased through the Highways Committee, and we recommend:—'That Regulation No. 662 be amended by the insertion before the word 'Stores' of the words 'Highways Committee or the'; and that the regulation, as so amended, be approved."

Liquidations. — HARROW ROAD AND PADDINGTON TRAMWAYS CO., LTD.—A meeting will be held on May 31st at 2 and 3, Norfolk Street, W.C., to hear an account of the winding up from the liquidator, Mr. A. R. Abbott.

RAPID LIGHT CONTROLLING SYNDICATE, LTD.—A meeting will be held on May 31st at 7, Victoria Street, S.W., to hear an account of the winding up from the liquidator, Mr. R. H. Pritchard.

ELECTRIC RAILWAY SIGNALLING SYNDICATE, LTD.—This company is winding up voluntarily, with Mr. C. F. Palmer, of 1, Broad Street Avenue, E.C., as liquidator.

Trade Announcements.—MR. G. BRAULIK, 8, Lambeth Hill, London, E.C., has been appointed sole selling agent for the United Kingdom and British export of a quick water heater for washstands patented by H. Löfquist, of Stockholm. We have received an illustrated leaflet describing the apparatus.

MESSRS. FIELD & CO., electricians, have opened premises in Station Street, Burton-on-Trent.

Premises at 38, Southport Street, Barnstaple, have been taken by MR. F. BICKFORD, electrical engineer.

MR. HANSON PERRY, electrical engineer, of Douglas, Isle of Man, has removed his offices to Cronkbourne Road. His stores remain at 28, North Quay.

Prices Advance. — MESSRS. G. ST. JOHN DAY (PATENTS), LTD., of Oldham, announce that owing to material and labour costs having advanced, their prices are increased by 10 per cent. from May 2nd.

LIGHTING and POWER NOTES.

Aberdeen.—According to a statement by the city electrical engineer, 34 men of the department have enlisted, and to prepare for next winter, and to keep the works running it has been necessary to train the clerical staff as switchboard attendants. The number of power consumers since the opening of the war has increased by 17, and over half a million more units were generated during the first seven months of the war as compared with the returns of the corresponding period in the previous year.

Acton.—PRICE INCREASE.—The Chamber of Commerce has lodged with the U.D.C. a protest against a proposed 10 per cent. increase in the charges for current by the Metropolitan Electric Supply Co., it being pointed out that the legal maximum charges were already being paid. The Council has decided to point out to the company that an increase of 10 per cent. would press somewhat hardly on consumers, and suggest that any increase should not exceed 5 per cent.

Australia.—The Electricity Committee of the Sydney Municipal Council recommends that, as the replacement parts for the steam turbine, which broke down in June, 1914, are being fixed in place, the order on the British Westinghouse Co. for a complete turbine be cancelled, and the company compensated for the loss.

The ratepayers of Warragul, Vic., are to consider the advisability of installing electric light and the extension of the Gas Co.'s contract has been deferred pending the result; in the meantime the engineer has been instructed to secure the site for a power house.—*Tenders.*

The Poowong and Jeetho (Vic.) Shire Council has appointed Mr. V. J. Crowley, of Melbourne, to report upon the electric lighting scheme of Korumburra and to supervise the complete overhaul of the plant.—*A. M. Standard.*

Barking. — PROPOSED LOAN. — The U.D.C. having applied for a loan of £18,000 for electricity purposes, the L.G.B. has intimated that unless the expenditure is necessary for military purposes, it would be unable to sanction a loan at the present time. The Council has requested the L.G.B. to hold a local inquiry with regard to the loan.

Basingstoke. — LOAN SANCTION. — The L.G.B. has sanctioned a loan of £4,100 to enable the T.C. to extend the mains to the works of Messrs. Thornycroft. The cables are also to be extended to the works of Messrs. Mussellwhite, at Eastrop.

Blackburn.—YEAR'S WORKING.—The surplus profit on the year's working of the electricity department, amounts to £2,348, compared with £5,037 last year. Sales of energy realised £43,334, or £1,103 less than last year. Generation of electricity cost £13,798, or £376 less than last year; distribution £2,938, being £270 more; lamps, fittings and motors £2,831, £406 more; rates and taxes £2,481, £56 more; and management expenses £2,437, or £62 more.

The Corporation has given formal notice that application has been made to the B. of T. for consent to erect a generating station at Rishton.

Black Rock (Co. Dublin).—E.L. SCHEME.—The U.D.C. has received the Local Government Board's sanction to its electric lighting scheme, and will proceed with it on securing Treasury sanction for borrowing the necessary funds.

Bootle.—BULK SUPPLY.—The T.C. has applied to the B. of T. for consent to supply current in bulk to the Liverpool District Lighting Co., Ltd., and the B. of T. has intimated its intention to make the necessary order.

Bridlington.—REFUSE DESTRUCTOR.—The T.C. has decided to renew its application to the L.G.B. for an inquiry to be held relative to the provision of a refuse destructor for the town.

Chelmsford.—SUGGESTED E.L. PURCHASE, &C.—The T.C. has accepted a rebate of £200 on the public lighting contract from the Electric Supply Corporation in respect of restricted lighting, and has referred the question of any further reduction to a Sub-Committee. The Lighting Committee is to consider the question of exercising the option of purchasing the undertaking of the Electric Supply Corporation, for which formal notice has to be served before January 20th next.

Colne.—For the year ended March 31st, there was an increase of 95,679 units in the quantity of electricity sold as compared with the previous year.

Connah's Quay.—PROV. ORDER.—The U.D.C. has been informed that the B. of T. will not extend the area of supply under the prov. order for E.L. beyond the Council's district, and that the order was being made upon that condition.

Continental.—RUSSIA.—Messrs. Siemens & Halske hold the contract for electrically lighting the town of Voronezh. The town is going to use its option of buying the company out on November 23rd this year, and will build its own electric station for lighting and traction, and raise a loan of 1,025,000 roubles for this and other purposes. It intends to reconstruct the old electrical station.

Coventry.—YEAR'S WORKING.—The annual report of the electricity department shows that the revenue for the past year amounted to £77,913, as compared with £71,207 in the previous year. The net profit on the year's working was £22,829, as against £21,749 in the previous year. The Committee recommends that £6,000 be transferred for the relief of rates. The total number of units sold increased from 16,508,338 to 20,249,018, an increase of 3,740,680.—*Birmingham Daily Post.*

Derby.—PROPOSED LOANS.—The E.L. Committee of the T.C. recommends application to the L.G.B. for sanction to loans of £3,488 for mains, and £569 for motors, already expended; and for £1,000 additional for mains and motors for supplies for war purposes only.

Dublin.—Basing its calculations on the probable prices, the Corporation Improvements Committee has reported that £2,700 will be required during the ensuing year for coal, and £5,000 for electricity—a total of £7,700 against the Corporation provision of £6,000.

Eccles.—The Watch Committee has asked the Town Clerk and the borough electrical engineer to report on the suggestion by H.M. Inspector of Factories respecting the desirability of electric wiring and fittings, installed in factories by private electricians, being inspected and approved by the borough electrical engineer or other responsible official.

Edinburgh.—YEAR'S ESTIMATES.—The estimated expenditure by the Corporation lighting department for the ensuing year is £39,745, a decrease of £3,595 as compared with the net expenditure last year. The decrease is due mainly to the expected saving in respect of the restricted lighting of the city streets—the sums estimated with respect to electric and gas lamps being in each case £1,440 less than last year.

It was reported to the Electric Lighting Committee of the Corporation that the draft provisional estimates for the coming year showed a deficit of over £5,000. This was more than accounted for by the increased coal bill, which had gone up by £10,000. The Committee at its next meeting will consider whether the estimated deficit is to be made up by increasing the charges or otherwise.

According to a Glasgow paper, the Electric Lighting Committee has received inquiries as to the cost of energy for charging electric vehicles, and has decided to recommend that the charge be 1d. per unit, as the accumulators would be charged during the night.

Erith.—BULK SUPPLY, &C.—The West Kent Electric Co. has applied to the U.D.C. for terms for a bulk supply of current for lighting 200 cottages to be erected in Colyer's Lane. The Council has referred the matter to the chairman, clerk, and engineer to take such steps as they may deem necessary. The engineer having reported that the question of extending the generating plant was becoming a matter of some urgency, has been instructed to submit a report, including a comparative statement showing the consumption by power consumers during the past four or five years, and his observations in connection with the probability of bulk supplies in the district.

Haslingden.—LOAN SANCTION.—The L.G.B. has sanctioned the borrowing of £4,600 for mains and special trench work, and £2,770 for services, switchgear and transformers.

Heywood.—INCREASED PRICES.—An advance of 10 per cent. in charges for electricity came into operation last week, the increase being necessary in consequence of the high price of fuel.

Ilford. — ELECTRIC COAL WAGON. — The electrical engineer in a report favours the purchase of an electric vehicle for the cartage of coal, but before making a recommendation on the subject, the Lighting Committee has arranged for an inspection. The Committee has adjourned consideration of certain new tariffs. The department's showroom in High Road has been closed, and since adapted for use as a sub-office for inquiries.

Keighley.—At a meeting of the T.C. last week, reference was made to the economies being adopted with regard to expenditure on municipal undertakings. In regard to the electricity department it was stated that threequarters of the consumers on the mains were engaged on Government work, and owing to this fact and the constantly increasing demands upon the supply, the month of March showed an increase in revenue of £500, as compared with the corresponding period of 1914.

Kingston-on-Thames. — INCREASED PRICES. — The town clerk reports that in view of the recent decision of the Council not to accept a recommendation of the Lighting Committee that no alteration should be made in the rate of charge for current supplied for heating, cooking and fixed motors, the rate for such purposes would now be 1⅛d. per unit. The L.G.B. has requested to be furnished with particulars of the excess expenditure amounting to £5,792 on loans already sanctioned for purposes of electric lighting.

Kingstown.—The electrical engineer, Mr. J. P. Tierney, has been directed by the Council to submit alternative schemes for a generating station in connection with the electricity supply scheme.

London.—BERMONDSEY.—The Electricity Committee, on the report of the engineer, recommends that the stokers of the three Howden boilers at the electricity works be replaced by chain-grate stokers, and that the offer of Messrs. Bennis & Co. for the supply of such grates be accepted. The engineer considers that with the increased boiler power the question of obtaining a bulk supply can be postponed for another year.

L.C.C.—The Finance Committee recommends that the Council sanction the borrowing by the Battersea B.C. of £9.000 for the electricity undertaking, viz, £6,050 for mains, £1,176 for house services, and £1,774 for meters; also £15,000 for electricity mains by the Stepney B.C.

Sanction is also recommended to the borrowing by the Woolwich B.C. of £35,000, being £9,000 for buildings and £26,000 for electrical plant, providing the B.C. agrees that the balance remaining at April 1st, 1920, in respect of loans originally granted for 42 years for the old plant, should be repaid in half the period unexpired at that date.

The London Education Committee proposes to install electric power at the Aristotle Road (Clapham) metal work centre for driving the machinery.

The Holborn B.C. Works Committee has decided in connection with the reduced street lighting that no further steps can be taken to modify the street lighting charges by the Metropolitan E.S. Co., which has expressed its disinclination, for certain reasons, to interfere with the terms of the contract, which is a 10 years' one.

Malvern.—INCREASED PRICES.—In view of the increased cost of production, the U.D.C. has advanced the price of current by 1d. per unit.

Manchester.—INCREASED PRICES.—Ordinary consumers of electricity, as distinct from large consumers whose payments for current are regulated by a sliding scale, are to be charged an increase of 10 per cent. for light, and users of power an increase of 15 per cent. Consumers who are under the Norwich system and are charged 12½ per cent. on the assessable value of their houses, with the price of the unit in addition, will pay 15 per cent. in future. It will be remembered that a hint was dropped recently that increased charges would be necessary owing to the increased cost of coal and labour.

Merthyr Tydfil.—The Electric Traction and Lighting Co., Ltd., has applied to the B. of T. for consent to the use of overhead lines in the district for the transmission of energy at a pressure of 11,000 volts.

Mirfield.—INCREASED PRICES.—Owing to the increased cost, the U.D.C. has advanced the price of energy for power and street lighting by 10 per cent.

Nelson.—YEAR'S WORKING.—The electricity department has made a net profit during the past year of £1,138, as against an estimated profit of £1,420. In view of the circumstances, the result is regarded as most gratifying, and constitutes a record for the department, excepting only the returns for 1913-14.

Northampton. — PROPOSED POWER STATION. — The Northampton Electric Light and Power Co., Ltd., has made an application to the B. of T. for consent to the construction of a generating station at Far Cotton, one of the growing suburbs of the town. The site is on the river and near two railways. The disadvantage of the present station is that it is in such a position that a railway siding cannot be constructed.

Nuneaton.—RATE RELIEF.—The T.C. has decided to contribute £500 out of the past year's profits on the electricity undertaking towards relief of rates.

Rugby.—The U.D.C. has sanctioned the laying of E.I. cable in new streets off the Lodge Estate, at an estimated cost of £300.

Salford.—PROPOSED LOANS.—The Electricity Committee has directed application to be made to the L.G.B. for a further sanction to borrow £5,466 to cover capital expenditure incurred in connection with the undertaking since March 12th last, in respect of loans sanctioned by the Board prior to that date.

Southampton.—The price for charging electric vehicle batteries has been fixed at 1½d. per unit. It has become necessary to increase the mains in the northern district at a cost of approximately £500, and the purchase of the necessary cable has been left in the hands of the engineer and chairman of the Electricity Committee.

Stoke-on-Trent.—INCREASED PRICES.—An advance of 10 per cent. in the charges for current has been made by the T.C.

Waterford.—L.G.B. INQUIRY.—An inquiry into an application by the Corporation for a loan of £30,000 for the purpose of carrying out the electric lighting project, was held at the City Hall last week.—*Freeman's Journal.*

Wharfedale.—At the last meeting of the Guiseley District Council, in view of the withdrawal of the Yorkshire Electric Power Bill, it was suggested that the time was now opportune to make some arrangements for the supply of electricity from a municipality at present owning electricity works, or a privately-owned power company, or for the combined District Councils to manufacture current themselves. It was agreed that the Guiseley Council should convene a conference of adjacent District Councils to ascertain the position occupied by them with respect to any lighting order that might be in existence.

TRAMWAY and RAILWAY NOTES.

Blackburn.—YEAR'S WORKING.—In the tramways department the surplus profit for the year just closed is £1,572, against £4,011 in the previous year. Traffic revenue amounted to £65,158, a decrease of £3,034. Excluding Accrington borough, the mileage was 1,121,769, or 27,693 miles fewer than in the previous year, and the mileage run in Accrington was 65,014. The passengers carried numbered 12,223,569, against 12,731,532 in the previous year.

Bournemouth.—YEAR'S WORKING.—The annual report of the Corporation tramways shows a net profit for the year of £9,350. The total traffic receipts for the year ended March 31st were £102,346, being a decrease of £2,623 on the previous year. Up to the declaration of war in August, the receipts were above the average, and a profit of £20,000 was fully anticipated. The year's net profit would have been much larger but for the fact that from August to March 31st £2,352 was paid as contributions towards the members of the staff who joined the forces.—*Daily Telegraph.*

Bury.—CARRIAGE OF GOODS.—At the recent meeting of the Associated Chambers of Commerce a resolution was brought forward by the Bury Chamber expressing the view that considerable commercial advantage would accrue through the ultisation of municipal tramways for the carriage of goods, and recommending individual chambers to further their use. It is now announced that the Bury tramways manager has favourably considered the proposal, and is prepared to give information to persons wishing to use the tramways in the way suggested.

Chester.—TRAMWAY TRAFFICS.—For the year ended March 25th there was an increase in the receipts from the tramways of £141, the increase in the number of passengers being 58,045.

The Tramways Committee has decided that no more men of serviceable age shall be engaged as conductors unless it be proved that they have been rejected or incapacitated for service in H.M. Forces.

For the time being, at any rate, the Tramways Committee has decided not to appoint women as tram conductors.

Colne.—YEAR'S WORKING.—The total revenue of the tramways for the year just ended amounted to £13,188, or 10·6d. per car-mile. The receipts amounted to £13,082, a decrease of £1,606, compared with the previous year; the passengers carried numbered 2,363,113, and the cars ran 296,021 miles. The greater portion of the decrease in receipts is attributed to the war.

Dundee.—At a meeting of the Corporation Tramway Committee it was stated that the revenue would be £1,500 less than last year, and that, due to the war bonus and payments to the dependents and enlisted men, the expenditure would be increased by that amount.

Eccles.—The T.C. has entered into an arrangement with the Salford Corporation, under which the latter, for the sum of £800, will repair the whole of the tramway overhead electrical equipment in the borough, and for a payment of £35 per mile of single trolley wire per annum, in addition to cost of new material provided, less value of scrap received, maintain the overhead equipment for a period of 10 years from April 1st, 1915.

Haslingden.—YEAR'S WORKING.—The traffic receipts of the tramways during the year ended March 31st amounted to £7,965, compared with £8,489 for the previous year, a decrease of £524. The mileage run was reduced by 5,625 miles.

The chairman and vice-chairman of the Tramways Committee are to consider and report upon the purchase of a new motor tower wagon or a vehicle suitable for conversion.

Leeds.—WAR BONUSES.—The General Purposes Committee, on Monday, considered an application from members of the Tramwaymen's Union in the service of the Corporation for an increase of war bonuses now being paid under the Corporation scheme. The Committee declined to accede to the request, and took the view that the present scale of allowances is adequate.

London (L.C.C.).—According to the *Evening News*, dissatisfaction is reported amongst the men working on the L.C.C. tramways, and a mass meeting is being called for May 15th. The wages agreement under which the men are working expires on June 26th. Very few of the drivers and conductors benefit from the war bonus given to L.C.C. employés earning less than 30s. a week.

Nelson.—YEAR'S WORKING.—During the past year the net profit yielded by the light railways was £314, as against an estimated profit of £828. In his annual report, Mr. Naylor (manager) states that, in view of the outlook, the proposed venture with regard to railless traction has been left in abeyance.

Salford.—FEMALE LABOUR.—The Tramways Committee has decided to employ 16 women as car conductors as an experiment. They will work six hours a day, and will be paid the standard rate of wages. Women washers are to be employed for day work at the depôt, so as to liberate men for night work.

The local branch of the Tramway Workers' Union has adopted a resolution to the effect that the members will not entertain the question of female labour in Salford, and that they will refuse to work with women. The matter was to be considered on Tuesday at a meeting of the Tramways Committee.

TELEGRAPH and TELEPHONE NOTES.

Austro-Spanish Wireless.—Since March 22nd a radiotelegraphic service has been established between the Austrian wireless station at Trieste and the Spanish station at Barcelona. The tariff is 29 centimes per word.

Russia.—The Minister of the Interior has prepared an instruction on the order for levying a single tax on telephones in Russia, except on such apparatus as have been installed for free use, and also excepting Finland. The tax amounts to 10 roubles for each apparatus. For supplementary apparatus, no matter how many, the same rate must be paid. In case of transfer of apparatus the most recent user becomes responsible for the tax.

Spain.—The Spanish National Submarine Telegraph Co., owing to the expiration of its concessions for submarine cables, is in liquidation.—*Journal Télégraphique.*

Wireless Telegraphy.—It is reported from New York that plans are being prepared by experts of the U.S. Navy Department for the establishment of a wireless telegraph station at Cape Cod, which will be equipped with an apparatus specially designed to give assistance to ships groping their way up and down the Atlantic during dense fogs. The apparatus, although of foreign origin, has been perfected by an American naval officer in such a way that it will, it is claimed, be possible to locate a calling ship by the measurement of the radio waves and the assistance of a compass.

The Australian Government is making arrangements to equip the trans-Continental railway works with four wireless plants, so as to enable the working parties to keep in touch with each other, and thus avoid delays. The sets have been designed by the Commonwealth engineer for radiotelegraphy (Mr. Balsillie). Each will have a range of about 150 miles, but will rarely be required to work over more than 20 to 30 miles.—*T. and T. Age.*

Wireless Telephony.—Some time ago the Japanese Department of Communications established a system of wireless telephonic communication between Toba, in the Province of Shima, and the Island of Ishijima. The service having proved extremely useful to shipping, it is reported that the Department has decided to establish wireless telephone stations at five other ports, the range of communication in each case being between 40 and 50 miles.

CONTRACTS OPEN and CLOSED.

OPEN.

Argentina.—For the first section of the National College at Salta (cost £34,300) an electrical installation and telephones will be required, and public tenders are to be invited by the Direccion General for carrying out the works.

Australia.—MELBOURNE.—May 18th. Four 250-K.V.A. three-phase transformers; 9,680 yards ·05 sq. in., three-core, lead-covered cable, for the City Council. See "Official Notices" April 30th.

May 19th. Victorian Railways. Meters, coasting recorders or other energy-checking devices for train operation on the multiple-unit system, D.C., 1,500 volts. See "Official Notices" April 30th.

June 15th. City Council. Four mechanically-fired boilers, one turbine-driven boiler-feed pump, two fuel economisers, circulating water pumps. City Electrical Engineer. Specifications from Messrs. McIlwraith, McEacharn & Co., Ltd., London, E.C.

SYDNEY.—June 16th. Deputy P.M.G. 400 Morse sounders, American pony pattern. (Schedule No. 449.)*

July 19th. Municipal Council. One or two 12,000-KW. turbo-alternators (Contract No. 363).* A copy of the specification can be obtained from the City Electrical Engineer, Sydney.

July 19th. Steel towers for 33,000-volt transmission line. Specification (10s. 6d.) at E.L. Department, Town Hall.

TOOWOOMBA.—June 7th. 480-volt D.C. electrically-driven centrifugal well-sinking pump, 30,000 gallons per hour, against a head of 200 ft. max. Deposit 2½ per cent. City Engineer.

Specifications for the items marked * can be seen at the B. of T. Commercial Intelligence Branch in London.

China.—SHANGHAI.—May 20th. 2,600 yards of three-core E.H.T. armoured cable, and 79 three-phase induction motors, for the Municipal Council. See "Official Notices" to-day.

Darlington.—May 20th. Corporation. Cast-iron condenser water pipes. See "Official Notices" to-day.

Dover.—May 18th. Six electric vehicles, for the T.C. See "Official Notices" to-day.

Finchley.—May 31st. U.D.C. Wiring, for light, 100 workmen's dwellings. See "Official Notices" to-day.

France.—The Administration des Chemins de fer de l'Etat, Paris, wants 46 A.C. motors of 10, 15 and 20 KW., for the new workshops of Sotteville; particulars from the Bureaux du Service Electrique (1re division), 43, Rue de Rome, on Tuesdays and Fridays, 3 to 5 p.m., up to May 14th. The Administration also wants motor-compressors for railway automobiles; particulars from the Bureaux du Service Electrique (3e division), 72, Rue de Rome, between the same hours, up to May 17th.—*La Lumière Electrique.*

Leeds.—May 26th. Corporation. Steam, feed and water pipes. See "Official Notices" to-day.

Leigh (Lancs.).—May 21st. One vertical tube boiler, one 250-KW. rotary converter or motor converter, one switch panel, for the Borough Electricity Committee. See "Official Notices" April 30th.

London.—May 12th. L.C.C. Installation, about 210 wiring and 250 lighting points, at Sebbon Street Elementary School, Islington, N. See "Official Notices" April 30th.

The Highways Committee recommends that tenders be invited from selected firms for the supply of foundry plant for the central car-repair depôt.

Manchester.—June 2nd. Corporation. Coal-unloading crane, conveying plants, &c. See "Official Notices" to-day.

Norwich.—May 11th. 5,000 tons of coal, peas or slack, for the Electricity Department. Forms of tender from Mr. F. C. M. Long, City Electrical Engineer.

Sheffield.—May 28th. Two natural draught cooling towers complete. For the Electric Supply Department. See "Official Notices" to-day.

South Africa.—JOHANNESBURG.—June 1st. Municipal Council. 24 double-pole, automatic, oil-immersed circuit breakers of a continuous carrying capacity of 200 amperes (Contract No. 971). Specifications, &c., from the Controller of Stores, Municipal Offices, Plein Square, Johannesburg. Tenders to Town Clerk.—*Board of Trade Journal.*

Spain.—May 18th. Plant and material for a hydro-electric station in connection with the Principe Alfonso drainage works, Province of Palencia. Tenders, description and deposit (£41) to Negociado de Aguas del Ministerio de Fomento, Madrid. Local representation.

June (end). Director-General de Correos y Telégrafos, Calle de Carretas 10, Madrid. Laying a submarine cable from Cadiz to Laraiche, and repair of certain cables. Further particulars at Board of Trade Commercial Intelligence Branch in London.

Tasmania.— LAUNCESTON.— July 26th. Sub-station equipment. Section I, Converter machine, switchgear, &c.; Section II, Underground feeder cable. Specification (21s.) from the City Electrical Engineer, Town Hall.

Winchester.—May 11th. Corporation. Twelve months' supply of steam coal, for the Electricity Department. See "Official Notices" April 30th.

CLOSED.

Brighton.—The T.C. has accepted the tender of Richardsons, Westgarth & Co., Ltd., for a surface condenser for the Southwick power station, at £1,925.

Condensing Plant Contracts.—The Mirrlees Watson Co. has recently received orders for condensing plant as follows:—

Torquay Corporation.—Third set.
South Leicestershire Colliery Co.—Two sets.
Millom & Askam Hematite Co., Ltd., per Messrs. Fraser & Chalmers.—Fifth set.
Compagnie Francaise Thomson-Houston, Paris, for Tulliere power station.—Fourth set; also for Athens power station.—Third set.
Tharsis Sulphur and Copper Co., Ltd.—Three sets.
Also plant for Bourges (France), Senegal, Russia, Japan, Straits Settlements and West Indies.

Derby.—The T.C. has accepted a tender from Messrs. Edgar Allen & Co., Ltd., for tramway rails.

Grimsby.—The T.C. Lighting Committee has directed that half the quantity of meters required for a period of two years be purchased from the British Thomson-Houston Co., and the remainder from Messrs. Chamberlain & Hookham, and Messrs. Ferranti, Ltd., in equal quantities.

Halifax.—The Tramways Committee has accepted the tender of the General Electric Co., Ltd., at £2,563, for three rotary converters, transformers, and switchgear required in connection with conversion of the Hipperholme and Hebden Bridge sub-stations plant to three-phase 50-cycle alternating current supply.

Hendon.—The tender of the Hendon Electric Supply Co., at £198, has been accepted by the Education Committee for wiring the Wessex Garden School. Four tenders were received. A similar number of tenders were also received for wiring the Bell Lane School; consideration of these has been deferred.

Liverpool.—The City Council is recommended to accept the tender of Messrs. Ferranti, Ltd., for a 12 months' supply of electric meters.

London.—HAMMERSMITH.—The Electricity Committee reports that Messrs. Johnson & Phillips, Ltd., the contractors for the supply of box frames, covers, boxes, &c., during the current financial year have written stating that since the acceptance of their tender they have received a number of Government orders, and that in consequence of a considerable number of men being specially allocated for Government work, the deliveries of the Council's order would be impeded. Under the circumstances the firm ask to be allowed to withdraw the tender. The Committee recommends the Council to agree with the request, and has directed the engineer to communicate with Messrs. W. Lucy & Co., Ltd., the next lowest tenderers, to ascertain if they are prepared to enter into a contract with the Council.

SHOREDITCH.—The Lighting Committee has accepted the tender of the Stirling Boiler Co. to supply and fix one pair of chain grate stokers for £415, including 250 spare links of the double lap type.

The following tenders have been received by the London Education Committee for installing electric lighting in the Darinton Road School, Wandsworth:—

Alpha Manufacturing Co.	(accepted)	£358
Johnson. O'Sullivan & Co.		394
Napier, Kimber, Ltd.		414
Wand Bros. & Co.		428
C. H. Cathcart & Co.		585
M. Mackie & Co.		587
Holland & Sons		804

BERMONDSEY.—The Electricity Committee has recommended the acceptance of the tenders of Messrs. Hy. Clark & Sons, Ltd., W. B. Dick & Co., Ltd., and the Silvertown Lubricants, Ltd., for engine oils during the ensuing 12 months.

L.C.C.—The Asylums and Mental Deficiency Committee has accepted the tender of Messrs. Tyler & Freeman, at £271, for installation of telephones, fire alarms and call-bells at the Maudsley Hospital.

Manchester.—The Electricity Committee has accepted the following tenders:—

Three three-wire balancers.—Lancashire Dynamo & Motor Co., Ltd.
Cable.—B.I. & Helsby Cables, Ltd.; Callender's Cable & Construction Co., Ltd.; Johnson & Philips, Ltd.; Western Electric Co., Ltd.; Union Cable Co., Ltd.; W. T. Glover & Co.
Three 1,250-K.V.A. static transformers.—British Westinghouse Co.
One 250-K.V.A. transformer.—British Electric Transformer Co., Ltd.
Three 1,000-K.V.A. three-phase static transformers.—Ferranti, Ltd.
One 650-KW. rotary converter.—British Westinghouse Co.
High-pressure steam valves.—Dewrance & Co. and J. Hopkinson & Co., Ltd.

The Corporation Sanitary Committee has accepted the tender of Messrs. Waygood Otis, Ltd., for repairs to the lift at the Civic Buildings.

The following tenders have been accepted by the Tramways Committee:—

Furnace coal.—Kelsall Bros., and J. Smith & Co.
Block tin.—John Mackie & Sons (agents for Cornish Tin Smelting Co., Ltd.).
Fishplates.—Bolckow, Vaughan & Co., Ltd.

The resolution of the Tramways Committee accepting the tender of Messrs. John Brown & Co., Ltd., for a portion of the Committee's requirements of steel car tires has been rescinded, and an amended tender of Messrs. Cammell, Laird & Co., Ltd., for the whole of the Committee's requirements of such tires has been accepted.

Meter Contracts.—Messrs. Chamberlain & Hookham, Ltd., have received the following contracts for meters for 12 months:—

Maidenhead.—D.C. meters.
South Shields.—A.C. meters.
Bradford.—A.C. and D.C. meters.

Messrs. Ferranti, Ltd., have received the following contracts. In all cases they are for the year ending March, 1916, excepting Alloa and Bradford, and these run to May, 1916:—

Belfast Corporation.—C.C. house service meters, 250/500-ampere sizes only.
Halifax Corporation.—C.C. house service meters.
Heston and Isleworth U.D.C.—C.C. house service meters.
Swindon Corporation.—C.C. house service meters.
Wimbledon Corporation.—A.C. house service meters.
Grays U.D.C.—C.C. house service meters.
Grimsby Corporation.—Portion C.C. house service meters.
Birkenhead Corporation.—C.C. house service meters.
Alloa T.C.—C.C. house service meters, 10-100 amperes inclusive.
Liverpool Corporation.—C.C. house service meters.
Borough of Kilmarnock.—C.C. house service meters.
Bradford Corporation.—C.C. and A.C. house service meters.

Nuneaton.—The T.C. has sealed a contract with Callender's Cable and Construction Co., Ltd., for the supply of cable.

Preston.—The Electrical Apparatus Co., Ltd., has obtained a renewal of the present contract from the National Electric Supply Co. for the sole supply of motor starters for a further period of 12 months.

Southampton.—The following tenders have been received for the supply of steel tramcar tires:—

J. Baker & Co.	£17
J. Brown & Co., Ltd.	20
Cammell, Laird & Co.	25

The acceptance of a tender has been left with the manager and chairman of the Tramways Committee.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, May 7th. At 8 p.m. At 39, Victoria Street, S.W. Informal discussion.

Association of Mining Electrical Engineers (Notts. and Derbyshire Branch).—Joint Meeting with National Association of Colliery Managers. Saturday, May 8th. At 3.30 p.m. At University College, Nottingham. Paper on "Protective Devices," by Messrs. E. Kilburn Scott and L. F. Fogarty.

Institute of Metals.—Wednesday, May 12th. At 8.30 p.m. At Institution of Electrical Engineers, Victoria Embankment, W.C. Paper on "The Passage of Electricity through Metals," by Sir J. J. Thomson, F.R.S.

Institution of Electrical Engineers (Birmingham Local Section).—Wednesday, May 12th. At 7.30 p.m. At the University, Edmund Street. Annual General Meeting.

(Yorkshire Local Section).—Wednesday, May 12th. At 7 p.m. At Philosophical Hall, Leeds. Annual General Meeting. Paper on "The Power Supply of the Central Mining—Rand Mines Group," by Mr. J. H. Rider.

Royal Society of Arts.—Wednesday, May 12th. At 8 p.m. At John Street, Adelphi, W.C. Paper on "Recent Progress in Pyrometry," by Mr. C. R. Darling.

Institution of Mechanical Engineers.—Friday, May 14th. At 8 p.m. At Institution of Civil Engineers, Great George Street, Westminster. Paper on "The Distribution of Heat in the Cylinder of a Gas Engine," by Prof. A. H. Gibson and Mr. W. J. Walker.

Royal Institution of Great Britain.—Saturday, May 15th. At 3 p.m. At Albemarle Street, W. Lecture on "Advances in the Study of Radio-Active Bodies," by Prof. F. Soddy.

Generous Gift to Leigh Infirmary.—In memory of his father, the late Alderman Thos. Greenough, Mr. Thos. R. Greenough, on behalf of his mother and himself, on Thursday last week handed over to the Leigh Infirmary a complete electrical and radiographical department in three divisions, at a cost of about £5,000.

Fatalities.—STIRLING.—William McClumpha, electrical engineer, who resided at Millhall Cottages, near Stirling, was killed instantaneously in No. 1 Pit, Polmaise Colliery. He was repairing a coal-cutting machine, when it was accidentally set in motion.

MANCHESTER.—At Manchester on Monday an inquest was held on William Dyson, aged 57. It appeared from the evidence that on April 16th the deceased, who was employed by the Calico Printers' Association, was instructed to repair an electric bell in connection with the hoist at the Oxford Street premises of the firm. He had to get to the top of the lift, and while he was carrying out the work his arm caught one of the control wheels, and the lift was set in motion. It ascended to the top and jammed Dyson's leg, the injury subsequently proving fatal. "Accidental death" was the verdict.

THE BOMBAY HYDRO-ELECTRIC SCHEME.*

By A. DICKINSON, M.I.E E.

It is proposed in this paper to give particulars of a large hydro-electric scheme known as the Tata Hydro-Electric Power Supply Co., Ltd., Bombay. The main object of this company is to supply electrical energy for use in Bombay, principally for power in cotton mills.

The hydraulic section of the scheme is exceptional, inasmuch as special lakes have been created, and the whole of the water for supplying the power is collected from the rain falling during the monsoon. Three reservoirs are being formed by constructing dams across valleys known as Lonawla, Walwhan, and Shirawta. From the reservoirs the water is conveyed in an open duct to the forebay, and thence through pipe lines to the power house, a distance of 13,000 ft., in which length there is a fall of 1,725 ft. The power house is situated at Khopoli, 43 miles from the receiving station on the Island of Bombay. (See map on p. 661.)

The present scheme is to install in the power house eight sets, each 11,000 B.H.P., and in the receiving station the plant necessary to deal with the power-house output. Five sets only are now installed in the power house, and the remaining three sets will be put down as water becomes available.

Generation is at 5,000 volts, 3-phase, 50 periods, the energy being transformed up to a line pressure of 100,000 volts.

Lonawla is a storage lake intended principally for use during the monsoon period, and, when this lake is empty, water is drawn from the lakes of Walwhan and Shirawta.

The lakes are formed by constructing across the three valleys dams with coursed rubble masonry faces and with heart of uncoursed rubble masonry.

Name of lake.	Height of dams in feet.	Length of dams in feet.	Surface acreage of lakes.	Water stored, millions of cubic feet.
Lonawla ...	19	5,500	986	361
Walwhan...	54	4,500	1,535	2,560
Shirawta ...	74	8,000	3,174	6,963

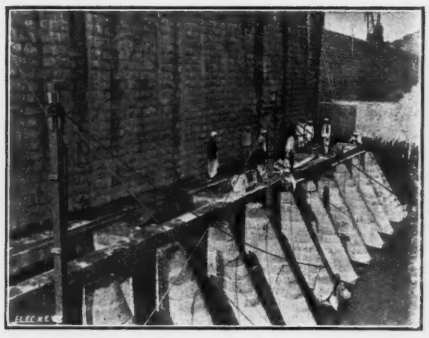


FIG. 1.—DAM AND SLUICES.

FIG. 2.—NATIVES PREPARING FOUNDATIONS OF DAM.

FIG. 3.—DAM UNDER CONSTRUCTION.

FIG. 4.—DUCT IN DEEP CUTTING.

FIG. 5.—DUCT IN TUNNEL.

FIG. 6.—DUCT ON HILLSIDE.

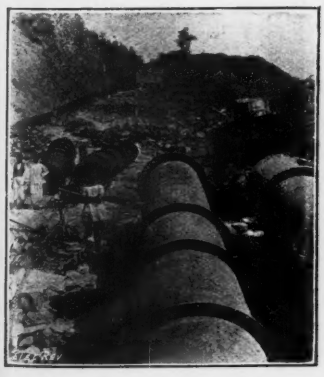


FIG. 7.—PIPE-LINE UNDER CONSTRUCTION.

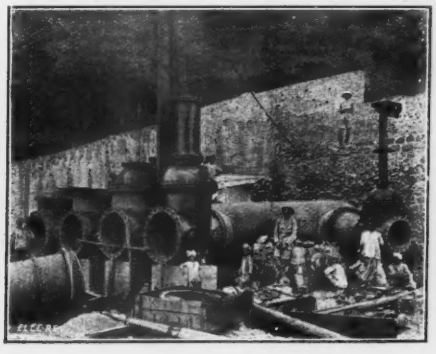


FIG. 8.—VALVES ON PIPE-LINE.

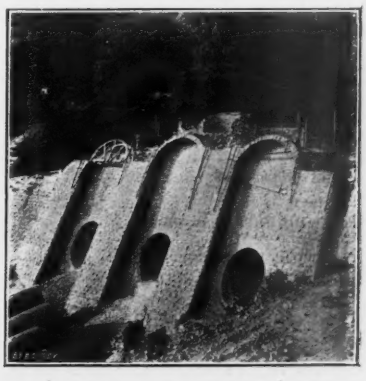


FIG. 9.—FOREBAY UNDER CONSTRUCTION.

*Abstract of paper read before the INSTITUTION OF ELECTRICAL ENGINEERS, April, 1915. A preliminary description appeared in the ELECTRICAL REVIEW of January 16th, 1914, p. 93. For the accompanying views (reproduced from lantern slides) we are indebted to the courtesy of the Author.—EDS.

E.

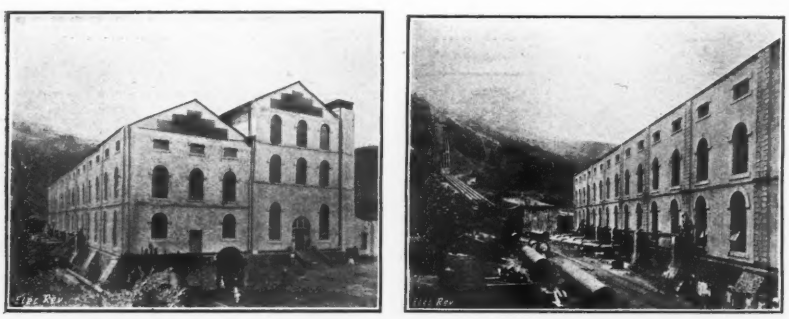
Two dams form Lonawla Lake, a main dam 3,600 ft. long across the valley and a smaller dam in which the sluices are built, 1,900 ft. long, the former being about 40 ft. high to the bottom of the foundation and 26 ft. above the lowest level of the valley, across the head waters of the Indrayani River.

Fig. 10.—One of the Dams approaching completion; Lake partly filled.

Walwhan dam is 4,500 ft. long and 75 ft. high to the bottom of the foundations, and 68 ft. above the lowest level of the valley.

Shirawta dam is 8,000 ft. long and 100 ft. high to the bottom of the foundations, and 92 ft. above the lowest level of the valley.

The total quantity of rubble masonry in the three dams is 926,000 cubic yards. The outlet of Shirawta Lake is connected to Walwhan Lake by a tunnel 5,000 ft. long through the hills, the formation being hard trap rock. At the inlet of this tunnel there is a head wall containing ample sluices to allow Shirawta Lake to be discharged into Walwhan Lake as desired to meet the required conditions of draw off.



Figs. 11 and 12.—Exterior of Power House, Khopoli.

The ducts have a water capacity of 120,000 h.p., the maximum velocity of the water being approximately 5 ft. per second.

The country through which the ducts pass is very difficult, necessitating the construction of 22 aqueducts. There are three tunnels cut through rock, one being 750 ft. in length, one 280 ft., and another 130 ft., making in all a length of 1,160 ft. In addition there are 10 cut and cover tunnels having a combined length of 2,630 ft.

The forebay has a storage capacity of 1½ hours with the whole of the eight sets working. Openings are proved in the dam for three 82-in. pipes.

The gates are operated by racks, either by hand or by an electric motor of 12 h.p. at 600 r.p.m. This gives to the gates a lifting speed of about 13½ inches per minute, so that fully to open the gates takes about 8 minutes.

Special provision has been made for speedily closing the gates from the power house in case of a burst pipe, or due to any other necessity. This is accomplished by a solenoid releasing the ratchet wheels so that the gates close by their own weight. On the gates is a device which automatically disconnects the electric motor before the gates reach the highest or the lowest positions. The gates are also fitted with automatic brakes so that when operating the gates from the power house they cannot be damaged by falling too quickly.

The inlets are protected by screens so constructed that one screen slides over the other, the object being to free the screens from grass or other debris collected thereon.

From the forebay the pipe line, which is one of the largest (as regards the horse-power transmitted) ever built for a water-power plant, conveys the water down the cliffs and steep slopes to the power house at Khopoli in the plains below. The scheme has been designed in two sections, two upper and eight lower pipe lines. The present installation (half the scheme) comprises one upper pipe line, a distributing pipe, and four lower pipe lines, the total length being about 13,000 ft., 8,200 ft. of upper and 4,800 ft. of lower pipe line.

The upper pipe line is built in three sections, decreasing from 82½ in. diameter and ⅜ in. thick to 72 in. diameter and 13/16 in. thick. The distributing pipe is 72 in. in internal diameter, 15/16 in. thick, and about 46 ft. long, with four 42-in. branches and one spare branch. The lower pipe line, starting from the distributing pipe, is of lap-welded steel tube 42 in. to 38 in. in internal diameter and ½ to 1½-in. thick. Near the power house, three exciter-turbine pipe-line connections are provided. The pipe lines are designed for a factor of safety of 4.5, calculated on the minimum tensile strengths and static heads.

The whole pipe line is laid above ground, provision being made for variations of temperature from 50° F. to 127° F. by expansion joints.

The waste-weir level at the forebay is 2,032 ft. and the power house floor level 309 ft. above the mean sea-level, giving a static head of 1,725 ft. to the centre of the turbine gate, with a pipe pressure of 743 lb. per square inch. With four turbines, each running at 11,000 b.h.p., the total loss of head is 66 ft.

The scheme has been designed for a normal plant capacity of 88,000 h.p. in eight main 11,000-h.p. sets, two 850-h.p. exciter sets, and eight step-up 3-phase 10,000 k.v.a. transformer banks, with the necessary switchgear, station auxiliary apparatus, and four outgoing lines.

The present building will take five main and two exciter sets, five transformer banks, switchgear, and auxiliaries, and two outgoing lines. The building consists of a turbine and generator room spanned by a 67-ton electric travelling crane, 5,000-volt bus-bar and oil-switch rooms, transformer compartments with a tramway passage and turntable for handling the transformers by means of trucks, and a repair shop, all these being on the ground floor, together with a 100,000-volt bus-bar and oil-switch room and transmission-line outlet tower located on the floors above.

The main sets consist of Escher-Wyss hydraulic impulse turbines of the horizontal type running at 300 revs. per minute and direct-coupled to Siemens Brothers three-phase generators. The exciter sets consist of Escher-Wyss tangential wheels, running at 600 revs. per minute and direct-coupled to Siemens Brothers compound-wound generators.

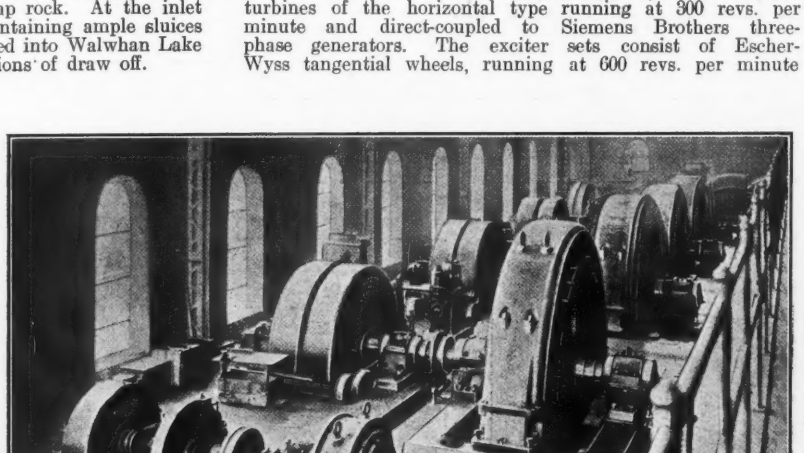


Fig. 13.—Generating Plant and Exciter in Power House.

The turbine wheels consist of cast-steel disks and buckets carried by Siemens-Martin steel shafts, with two ring-lubri-

cating bearings provided with water cooling. The nozzles are of the cast-steel deflecting type, and the governors are of the oil-pressure type fitted with hydraulic automatic servomotors, guaranteed to limit the speed variation to 2½, 5, and 12 per cent. when 25, 50, and 100 per cent. of the load is suddenly thrown off. A dash-pot connects the deflecting nozzle and

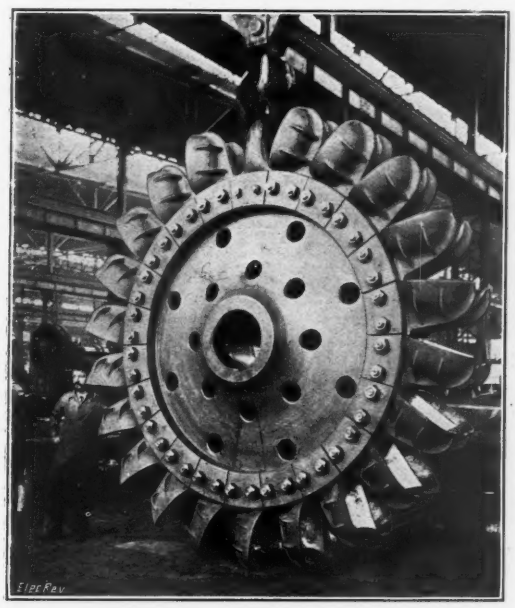


FIG. 14.—PELTON WHEEL OF 11,000 B.H.P.

the automatic speed governor, only the needle being connected rigidly to the governor.

In the event of a sudden closing movement, the servomotor diverts the jet from the runner-wheel, the levers being so arranged that during this operation there is no movement of the needle to close the nozzle, thus guarding against an increase of pressure in the pipe line. The nozzle then begins to return to its normal position, the needle at the same time decreasing and closing the jet outlet. This movement is followed automatically by the action of the dash-pot, the piston slowly sinking and the deflecting nozzle being returned to its normal position. With a slow closing movement of the regulator the nozzle is not deflected, owing to the slow movement of the dash-pot piston, the needle being slowly operated directly from the regulator.

The exciter turbines have separately-fitted cast-steel buckets, with similar governors guaranteed to limit the speed to 3, 6,

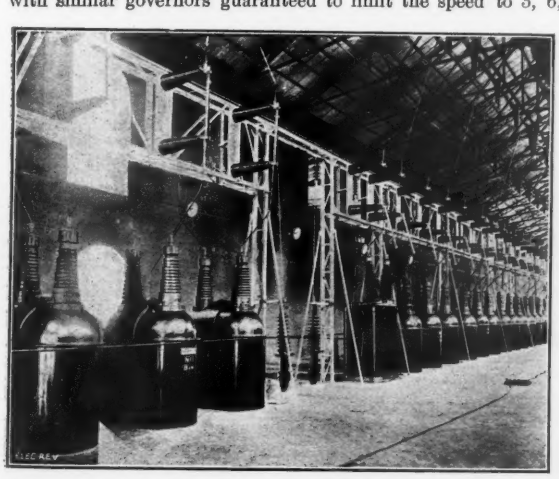


FIG. 15.—100,000-VOLT SWITCHGEAR.

and 16 per cent. when 25, 50 and 100 per cent. of the load is suddenly thrown off. The guaranteed full-load efficiency is 82 per cent. for the main, and 77 per cent. for the exciter turbines.

The main generators are of the rotating-field totally-enclosed type, designed for a normal load rating of 8,000 KW. at a power factor of 0.8 and 4,000 to 5,300 volts, 50 periods, 3-phase, with a temperature rise not exceeding 60° F. above air at 110° F., and 20 per cent. overload for 10 hours without injury. The full-load efficiency at 0.8 power factor is 94.3 per cent., with an inherent regulation of 9 per cent. at unity and 22 per cent. at 0.8 power factor. Induced ventilation is provided by means of fans on the rotor shafts, each machine being connected to the main inlet air-duct by a shutter and to the outlet air-duct to the atmosphere. These shutters are motor-operated with automatic control, so arranged that when the field switches are closed the shutters are open, and *vice versa*. The bearings are supplied with oil under pressure and are provided with water cooling.

The exciters are compound-wound machines designed for a full-load rating of 600 KW. at 250 volts, and 20 per cent. overload, the full-load efficiency being 93 per cent. The energy required for excitation at full-load and unity power factor is 25 KW. and at 0.8 power factor is 38 KW.

Each 3-phase transformer bank consists of three single-phase General Electric (U.S.A.), oil-immersed, water-cooled, static transformers, delta-delta connected and designed for a full-

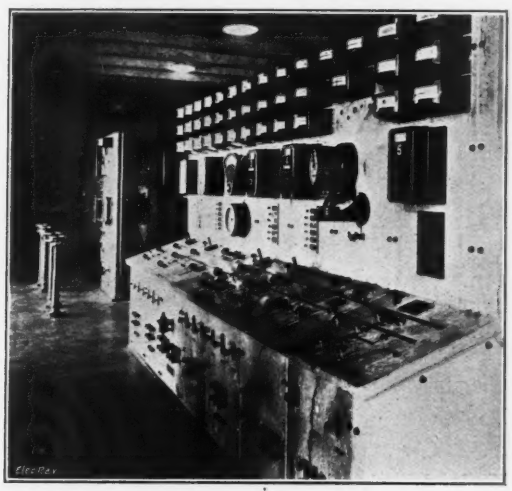


FIG. 16.—BENCH BOARD CONTROLLING HIGH-PRESSURE SWITCHGEAR.

load output of 3,333 K.V.A. at 0.8 power factor when stepping up from 5,000 to 100,000 volts, 50 periods, the temperature rise not exceeding 70° F. above cooling water at 75° F., with a water circulation of 950 gallons per hour. These sets are capable of 20 per cent. overload for 10 hours with a water circulation of 1,200 gallons per hour without injurious heating.

The full-load efficiency at 0.8 power factor is 98.1 per cent., and the efficiency at half load is 97.2 per cent. The regulation is 0.8 per cent. at unity power factor, and 4.6 per cent. at 0.8 power factor.

The transformers are of the shell type, having flat primary and secondary coils placed vertically and surrounded by a laminated sheet-steel core, the design and arrangement being such that the heat is conveyed from the interior to the water-cooling coils and tank by natural circulation.

The tanks are of boiler-plate steel, cylindrical in form, and are supported on a cast-iron base. The high-tension bushings

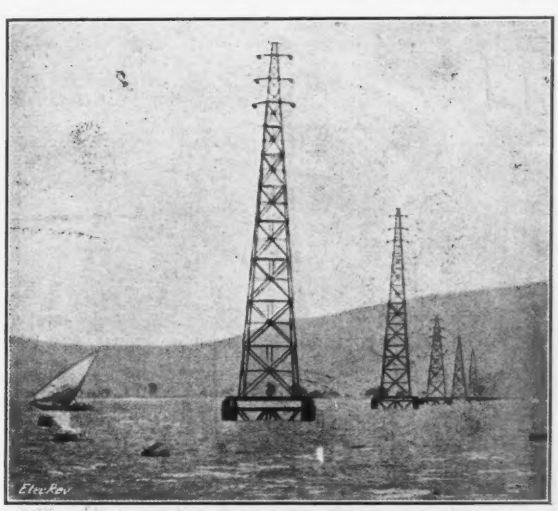


FIG. 17.—TRANSMISSION LINE CROSSING CREEK.

are of the compound-filled type, and consist of a conductor rod from the top to the bottom, which is surrounded by several concentric press-board insulating cylinders, separated by spaces, outside which the exterior wall of the bushing is built up of a number of annular rings of moulded insulating compound, interspaced with impregnated press-board disks of larger diameter than the rings in order to prevent leakage.

These disks and rings are cemented together and are tightly clamped by nuts at the top and bottom of the rod. The bushings are supported on cast-iron rings attached to the cover. The low-tension bushings are of porcelain.

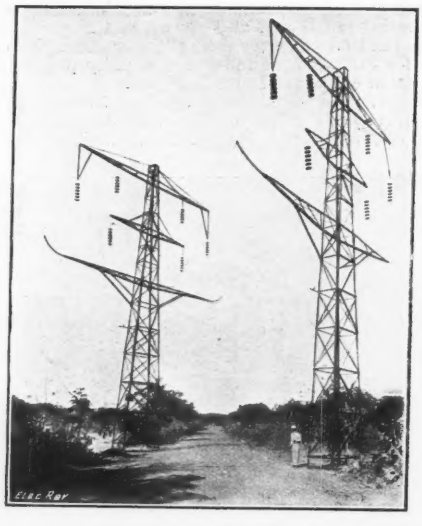


FIG. 18.—ROAD CROSSING ON 100,000-VOLT LINE.

The principal dimensions of the transformers are as follows:—Height to the top of the high-tension lead 16 ft., and to the cover 13 ft.; diameter of the tank 8 ft. The weight

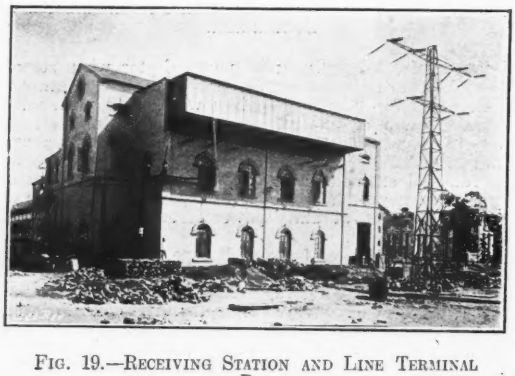


FIG. 19.—RECEIVING STATION AND LINE TERMINAL AT PAREL.

when assembled and filled with oil is 24 tons, of which the core and coils account for 11 tons. The quantity of oil required for filling is 2,300 gallons, and weighs 8 tons. The oil used is a specially-prepared mineral oil, treated before

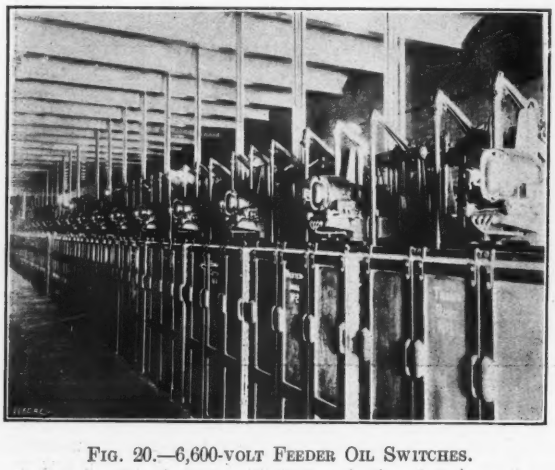


FIG. 20.—6,600-VOLT FEEDER OIL SWITCHES.

filling, and from time to time in service, in a drying and purifying outfit in order to remove moisture and foreign matter. This outfit consists of a portable set comprising a filter-press, a motor-driven centrifugal pump, and a strainer, and is mounted on a truck. It is capable of treating 1,500 gallons of oil per hour, the filtering medium being blotting paper.

Provision is made in the oil-pipe system for connecting this set to any transformer the oil of which requires treatment. The oil is tested in a standard testing set, consisting of an oil receptacle with a 0.2 in. spark-gap and contacts, and a testing transformer, and the oil is filtered until the puncture voltage is raised to 40,000 volts.

The water supply for the cooling coils is obtained from the pipe line through a reducing valve, a tank being provided for the system, whence the water is fed by gravity at an inlet head of about 20 ft. through the necessary piping and valves connecting up the three coils placed in the upper part of each tank, where they are constantly in contact with the heated oil rising from the windings and core.

Each bank of transformers on overload rating takes 3,600 gallons of water per hour at a temperature of 75° F., and the total requirements of the plant now being installed will be

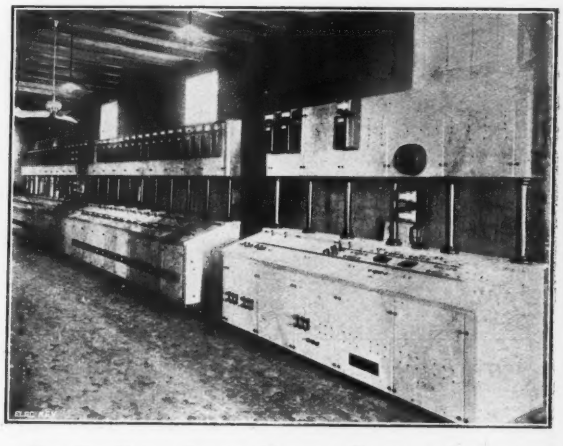


FIG. 21.—BENCH CONTROL BOARD AT RECEIVING STATION.

18,000 gallons of water per hour. Each inlet pipe is provided with a water-flow indicator and a discharge alarm.

Provision is made for operating each main unit with its own transformer bank, or through the 5,000-volt transfer bus-bar with any bank as required, and on the high-tension side the transformer banks and outgoing lines are operated in parallel.

The equipment consists of remote-control, electrically-operated oil switches and other apparatus operated from the

FIG. 22.—FEEDER CABLES FROM RECEIVING STATION.

benchboard located on a gallery overlooking the generator room. The apparatus in the generator circuits consists of three single-pole, non-automatic, solenoid-operated oil switches in cell compartments, disconnecting switches, and current and potential transformers; and in the high-tension side of the transformer banks three single-pole, automatic, solenoid-operated oil switches in tanks, disconnecting switches, and series relays; and similar equipments in the outgoing lines with the addition of current transformers, choke coils, and lightning-arrester equipment.

The high-tension oil switches are automatically tripped by inverse time-limit, overload, series relays which are mounted

on post insulators, a long rod from the relay closing a switch on the wall in the opening-coil circuits of the solenoids in the control wiring. Each switch unit is designed to operate as one switch with a breaking capacity of 40,000 K.V.A.

The transfer bus-bar system consists of a copper bar carried on insulators and sectionalised by means of disconnecting switches, and the high-tension bus-bar system of copper tubing which is carried on post insulators, suspended from the roof, sectionalised with disconnecting switches and provided with three single-pole, automatic, solenoid-operated oil switches in tanks between the fourth and fifth banks. This switch is tripped by means of inverse time-limit, overload relays in connection with current transformers.

The low-tension wiring consists of varnished cambric-insulated, fireproof-treated cables, and the high-tension copper tubing on post insulators is arranged for a phase-spacing of 5 ft. and a striking distance to earth of 3 ft., the circuits being taken through the roof of the transformer compartments in compound-filled bushings.

The switchgear equipment in the duplicate station transformer circuits from the transfer bus-bar consists of triple-pole automatic, motor-operated oil switches, instantaneous, overload series relays, and disconnecting switches.

The benchboard, which is capable of extension as required, is built of blue Vermont marble panels, mounted on pipe supports, with grille work at the back fitted with the necessary instruments, control switches, and indicating lamps, a mimic bus-bar system of remote-control apparatus for operating the generators and transformer banks, exciters, outgoing lines, station transformers, a 200,000-volt testing transformer, and a water rheostat testing equipment. Calibrating and testing terminals are provided and also a swinging bracket carrying illuminated-dial voltmeters and a synchronism indicator. For signalling to the generator-room floor a complete signal system is installed, with a signal stand near each generator.

The control switches are of the "push and pull" button type, single-pole double-throw, a green pilot lamp indicating the open position of the oil-switches, and a red pilot lamp the closed position.

The system is operated at 220 volts from a 60-ampere 8-hour battery, or from the 18-KW. motor-generator charging set if required. From this supply are also operated the motors of the generator field-rheostats, air-duct shutters, and turbine governors.

The auxiliary switchboard controls the supply from the two 312 K.V.A. 5,000/440-volt 50-period 3-phase transformers for station power and lighting. It is built of blue Vermont marble panels, carried on pipe supports. There are two transformer panels, six double feeder panels, a lighting panel, and a battery and motor-generator panel.

The bus-bars are of copper bar and are carried on insulators at the back of the board. The oil switches are of the triple-pole, automatic hand-operated type, and are fixed behind the board, the transformer circuits having current transformers and inverse time-limit overload relays, and the power circuits trip coils for automatic protection.

Voltage regulators are installed for maintaining a constant voltage on the bus-bars.

The lighting supply is furnished from three 30-KW. 440/220-volt 50-period single-phase transformers.

Two Willans-Siemens Diesel sets installed in an adjacent building provide a stand-by supply through a "tie" feeder provided on the board. Each set consists of a 100-H.P. 200-R.P.M. engine direct-coupled to an 80-K.V.A. 440-volt 50-period 3-phase alternator.

The voltage on the high-tension bus-bars is automatically maintained between certain limits by means of a Tirrill or Brown-Boveri regulator operating from a 100,000/100-volt potential transformer.

Each outgoing line is protected with choke coils and an aluminium-cell lightning-arrester equipment complete with horn gaps, disconnecting switches, a discharge alarm, and discharge recorders. The generators are star-wound for operation with an unearthed neutral, and for protection against pressure-rises are provided with "over-tension" apparatus, consisting of isolating switches, static dischargers, and star-delta horn-gap arresters.

The route of the transmission line is shown in fig. 23. It has a length of 43 miles from the power house at Khopoli to the receiving station on the Island of Bombay, and crosses two tidal creeks, one 10,000 ft. wide and 42 ft. deep at high tide, a railway, and several roadways. There will be four transmission circuits for normal parallel working, the circuits being carried on two lines of towers. Two change-over stations are provided, each with air-break disconnecting switches, and divide the line into three sections for cutting out or interconnecting different sections as required.

(To be continued.)

NOTES.

Smelting Tin Dross Electrically.—In the manufacture of tin plate large quantities of tin dross are formed consisting, say, of 50 per cent. tin, 8-12 per cent. zinc, and 10-18 per cent. iron. Hitherto it has been usual to charge batches of this dross, which varies considerably in composition, into reverberatory furnaces, together with soda ash and carbon sufficient to flux and reduce the dross, but yielding metal which is relatively impure, and needs more or less refining, according to the approximation of the actual furnace charge to that chemically desirable. If the dross be analysed before treatment, subsequent refining is simplified,

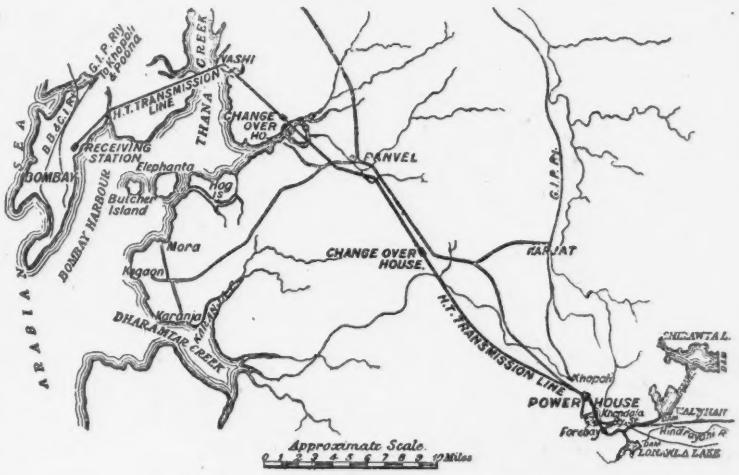


FIG. 23.—STORAGE LAKES AND TRANSMISSION LINE.

but such scientific procedure seems still to be exceptional amongst smelters, and, in any case, the ordinary reverberatory furnace process suffers from the defect that highly siliceous slags cannot be used, and practically all the copper and iron oxides in the dross are reduced to copper and iron, which must be separated from the crude tin by subsequent refining.

By using an electric furnace it is possible to eliminate this serious disadvantage of the reverberatory process. A slag containing 66·6 per cent. silica, 16·6 per cent. lime, and 16·6 per cent. soda can be used. This forms silicates from the iron and copper oxides present in the tin dross, but, if worked above 3,000°, the slag reduces tin oxide without forming tin silicate. At lower working temperatures as much as 15-17 per cent. tin collects in the slag, but at higher temperatures the loss is negligible, say, 0·5 per cent., and reduction is more rapid. As a result, metal tapped from an electric dross-furnace is much purer than from other furnaces, and the expense of refining is much reduced. To secure the best results it is necessary to analyse each batch of dross, and proportion the slag accordingly, but the cost of so doing, and the higher cost of energy for smelting, as compared with coal costs in reverberatory plant, are more than compensated by the saving in refining processes, reduced loss of tin and improved quality of product. There is no need to re-run slag in the electric furnace, owing to its low tin content; no addition of lead dross is required, and, by adding silica with the tin dross and carbon charge, the silica content of the slag can be kept constant and continuous operation maintained. It makes no difference to electrical resistance or results whether the slags are soda, lime or iron silicates, hence the formation of iron silicate does not disturb the working. Such is the experience quoted recently by R. S. Wile in describing the first commercially successful furnaces used in this service. These furnaces are of the shaft type, operated two in series on 220 volts, direct current, at 800 to 1,000 amperes. On starting the operation, slag is melted first by striking an arc and charging slag material round the electrodes. The latter are then raised gradually, and the operation is continued on the resistance principle, dross carbon and silica being fed in the proportions dictated by analysis. Air is practically excluded from the furnace, and, with 50 per cent. tin dross, the energy consumption is 300 KW.-hours per ton, *i.e.*, 700 KW.-hours per ton of tin produced.

Detecting Production Losses with a Tachograph.—With the aid of a recording tachograph, a device which shows the momentary speed variation occurring in the shaft or machine to which it is connected, the commercial department of the Dayton Power and Light Co., Dayton, Ohio, was recently able to show a prospective customer that his engine-driven factory shafting underwent a recurring speed loss of 6 per cent. during each revolution. The same tachograph applied to a similar installation driven by an electric motor showed speed variations reaching a maximum of only 0·5 per cent. Such a tachograph, according to Mr. J. C. Matthieu, power engineer for the company, is of great usefulness in revealing the production losses due to speed changes in engine-driven factories and in preparing the way for the obvious remed —electric motor drive.—*Electrical World*,

Institution and Lecture Notes.—Junior Institution of Engineers.—In the course of a lecture which he recently read before the Institution, on "The Electric Vehicle," Mr. R. J. Mitchell says that the phenomenal progress which the petrol vehicle has made during the past 15 years has obscured the fact that on the Continent of Europe, and more particularly in the United States, an immense advance has been made in the use of accumulator-propelled commercial vehicles. There are now in operation in the American Union nearly 75,000 of these vehicles. Immense improvement has been made on the mechanical side, largely due to the work of the regular automobile engineer. The electrical engineer, on the other hand, has contributed his quota, and accumulators, electric motors and controllers, &c., are rapidly nearing perfection; in fact, it may be said that for practical purposes the modern electric vehicle would remain an exceedingly useful machine were it not improved for the next 20 years. The advantages of the electric are manifold, and include very low cost of operation, a safe speed, very slight damage to road surfaces, great handiness of operation, occupation of little floor space, total absence of fire risk, smoke, smell, &c., and the fact that they can be driven by relatively unskilled labour, with a minimum of tuition. An average machine will give the equivalent of four gross ton-miles for one unit input of energy; this compares exceedingly favourably with the 30 to 35 ton-miles in commercial work obtainable from a gallon of petrol only on a very well tuned commercial petrol chassis. The mechanical wear and tear of the electric motor is infinitesimal as compared with that of an internal-combustion machine, and an average figure appears to be about a quarter of 1 per cent. per 1,000 miles of travel, on the initial capital cost of the chassis only. Tires for electric vehicles have a specially long guarantee, and in actual practice far outlast the terms of such warranty; and the modern accumulator has reached the point of being entirely dependable. The price of electrical energy also has come down to an average of 1½d. per unit, or thereabouts.

Institute of Metals.—Sir J. J. Thomson, O.M., D.Sc., F.R.S., will deliver this year's Institute of Metals May lecture, his subject being "The Passage of Electricity Through Metals," at the Institution of Electrical Engineers on Wednesday, May 12th, at 8.30 p.m. Visitors' tickets can be obtained on application to Mr. G. Shaw Scott, M.Sc., the Secretary of the Institute of Metals, Caxton House, Westminster, S.W.

In the absence, on active service, of Dr. G. D. Bengough, M.A., Honorary Investigator to the Corrosion Committee, now a captain in the Royal Garrison Artillery, the Council of the Institute of Metals has appointed Mr. W. E. Gibbs, M.Sc., as Acting Honorary Investigator to the Committee. Mr. Gibbs, prior to the outbreak of the war, was acting as Dr. Bengough's assistant in connection with the work for the Corrosion Committee. He is now engaged on a series of important investigations, the results of which will be embodied in the third report to the Corrosion Committee, which it is hoped will be presented at the forthcoming autumn meeting of the Institute.

Association of Mining Electrical Engineers.—At a joint meeting of branches of the National Association of Colliery Managers and the Association of Mining Electrical Engineers at Stoke, Mr. G. S. Corlett read a paper on the subject of colliery electric lighting.

At a meeting of the West of Scotland Branch of the Association of Mining Electrical Engineers, a paper was read by Mr. Andrew Gibson on "Bearings of Electrical Machinery."

Royal Institution.—The annual meeting of the members was held on Saturday afternoon, Sir J. Crichton-Browne, treasurer and vice-president, in the chair. The annual report of the Committee of Visitors for the year 1914, testifying to the continued prosperity and efficient management of the Institution, was read and adopted. Forty-four new members were elected in 1914. Sixty-two lectures and 19 evening discourses were delivered. The books and pamphlets presented amounted to about 338 volumes, making, with 652 volumes purchased, a total of 990 volumes added to the library in the year. The following gentlemen were unanimously elected as officers for the ensuing year:—President, the Duke of Northumberland; treasurer, Sir James Crichton-Browne; secretary, Col. Edmond H. Hills. The names of the managers included the following:—Sir Robert Hadfield, the Hon. R. C. Parsons, and Messrs. Alexander Siemens and A. A. Campbell Swinton.

Copper.—Messrs. H. R. Merton's statistical circular for April 30th shows an excess of supplies over deliveries, and, therefore, an accretion to European visible supplies, a state of things not easily anticipated under present circumstances. The increase is 2,431 tons. There is a small increase registered for stocks at Havre—23 tons—and English stocks are up by 758 tons. In detailed supplies, European arrivals from N. America are lower than last month, amounting to something like two-thirds of the pre-war average. Supplies from Spain and Portugal to England and France are well up at 2,415 tons, or one-third more than the pre-war average. The quantity under "other countries" is slightly lower than the pre-war average, as a set-off against unusually heavy supplies in March. Chile shipments are 4,218 tons, against a pre-war average of 3,280, while Australian are steady at 2,500 tons, but have not yet reached last year's figures. Total deliveries at 31,811 tons show smaller after the large quantity of last month, but have only been twice exceeded since last July. The considerable increase in price should have an influence on supplies for the coming month.

Appointments Vacant.—Assistant electrical engineer (£150), for Government of Malta; plumber jointer, for City of Sheffield Electric Supply Department. Particulars are given in our advertisement pages.

Electricity Committee-men and their Relatives.—A very lengthy discussion took place on Thursday last week, at the meeting of the Stoke-on-Trent Council, on the following motion:—"That it be an instruction to the chief electrical engineer that no further appointment of employés of the electricity department be made from amongst relatives of members of the Electricity Supply Committee." Councillor Sampson Walker said that there were six members of the Labour Party on the Electricity Supply Committee, and he was given to understand that five of them had sons working for the Committee. He did not suggest that they were not earning their money, but it was not proper in the interests of maintaining and preserving the clean hands of the Corporation. He also said that it was not fair to the electrical engineer. It was contrary to the interests of the Council, the chief engineer, and of public government. An amendment was moved as follows:—"That it be an instruction to the town clerk that no further appointment of employés who had relatives on the Council should be made." Alderman Leese, in the course of the debate, said that so far as he was concerned the difficulty would be ended by the resignation of both his sons that night. He complained that he had been most unfairly attacked. The amendment was carried by 30 votes to 29. A further amendment was carried that no member of the Corporation should sit on a committee under which he had a relative employed. The Town Clerk intimated, in reply to a question by a member, that the effect of the resolutions would be that the members affected must resign their positions on the committee or that the relatives must go.

A recommendation to increase the salaries of six members of the electricity staff was rejected. The Committee considered that in the interests of the department these salaries should be advanced, particularly in view of the fact that the staff had been seriously reduced owing to the war, and that extra duties had been thrown upon those remaining. The proposition was rejected on the ground that all Committees must be dealt with alike, as it had been decided that no increases of salaries should be given to those receiving more than £100 per annum. Speakers seemed to be quite incapable of seeing any reason why electricity staffs should be treated differently from others. Perhaps they may have a rude awakening when they find out that a great need exists for central station men just now

Electric Cooking Exhibit.—In connection with the "Women and their Work Exhibition," referred to on page 613 of our issue of last week, the Westminster Electric Supply Corporation were asked by the *Daily Express* to illustrate the advantages of electric cooking for women, and have organised quite an attractive exhibit with the aid of the Carron Co., Messrs. Ferranti, Ltd., Simplex Conduits, Ltd., W. A. S. Benson & Co., Belling & Co., and the Dowsing Radiant Heat Co. The annexe has been fitted up as an electric kitchen with cooking stoves by the various makers; there are tables showing many of the electric specialities of the above makers, such as electric heaters, grills, hot plates, irons, and oricalcum wire. There is also an attractive show table for articles which are cooked in the kitchen. Short lectures are given at 3 and 6 each day, which are well attended, and practical demonstrations go on all day. The space is well lighted by indirect and semi-indirect systems, and some handsome alabaster pillars and vases lighted internally are shown by Miss Austen. This exhibition, which closes to-day, should do good work in bringing the advantages of electric cooking before the public, not only in the Westminster Co.'s area, but in most parts of London.

The Budget Speech.—The Chancellor of the Exchequer, in his Budget speech on Tuesday, showed the necessity that exists from a financial standpoint for maintaining the exports of the country during the war. He also expressed, from the same standpoint of finance, the view that the time had arrived when recruiting should not be allowed to interfere with the output of munitions of war, and when it should be allowed to "interfere as little as possible with the output of those commodities which we export and which enable us to purchase munitions for ourselves and for our Allies." This new attitude of the Government will be welcomed by those conducting engineering and other works where, notwithstanding the shortage of skilled labour, and that the product is for war purposes, the recruiting sergeant has, as stated in our pages last week, continued to exercise his persuasive powers with success.

Patents and Alien Enemies.—Applications have been made to the Board of Trade for the avoidance or suspension of the following patents:—No. 22,565/12, granted to Honold for runners for Francis turbines, by J. J. Armfield; Nos. 12,868/05, 12,869/05 and 12,870/05, granted to Goldschmidt & Weber, for the detinning of tinned plates, by G. H. Forrester; and Nos. 27,516/11 and 19,696/12, granted to Eickhoff, for trough conveyors and motors for operating reciprocating conveyors, by Babcock & Wilcox, Ltd.

Karachi Installation: Correction.—In our reference to this installation in our "Lighting Notes" last week, it should have been stated that Messrs. Crompton & Co., Ltd., carried out the whole installation. This included the erection of the mains supplied by Messrs. Henley.

Educational.—MUNICIPAL TECHNICAL INSTITUTE, Romford Road, Stratford, E.—Seven lectures on "Some Industrial Applications of Electricity," will be given on Monday evenings at 7.30 p.m., commencing May 17th. Further particulars are given in our advertisement pages.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The municipality of Worcester, Cape Province, has appointed MR. JOHNSON TIGHE, of Cradock, as resident engineer for the new electric lighting installation. There were 23 applicants for the position. The consulting engineer (Prof. Bohle) urged the Council to commence the wiring of the municipal buildings, as probably the street wiring would be completed before the whole of the domestic services were ready.

Mr. H. H. Sutcliffe having declined the appointment as assistant electrical engineer at Aylesbury, the U.D.C. has now appointed MR. S. H. FOWLES, of Belvedere.

The Erith U.D.C. has decided to pay a month's salary (£33 6s. 8d.) to MR. COVENEY, the late electrical engineer, as a grant for services rendered in a supervisory capacity for two months after the expiration of his resignation.

MR. P. SMITH, meter inspector at the Ilford electricity works, has resigned his appointment.

The Derby Electric Lighting Committee has appointed MR. G. H. HAYES, as assistant mains superintendent, at £2 per week, *vice* Mr. W. R. Poole, resigned; and has increased the salary of MR. A. THOMPSON, switchboard attendant, from £2 2s. to £2 7s. per week.

The Coventry City Council E.L. Committee recommends that the salary of MR. G. TOUCH, engineer and manager of the electricity works, be increased from £650 to £750 per annum.

MR. H. D. WINCHESTER, district superintendent for the Newcastle-upon-Tyne Electric Supply Co., Ltd., at Durham City, was married to Miss Maidie Logie Robertson, at Edinburgh, on April 29th.

The salary of MR. J. FAIRCHILD, assistant electrical engineer at St. Annes-on-Sea, has been increased from £170 to £200 per annum.

Tramway Officials.—MR. L. J. YORKE, of the Underground Electric Railway mechanical engineering staff, who was gazetted to the 4th Yorks. Regiment in February last, left England for the front on May 5th.

General.—We understand that MR. F. S. GROGAN, who during his eight years' active work in connection with the Tricity cookers has acquired a unique position in the culinary branch of electrical engineering, is about to sever his connection with the British Electric Transformer Co., Ltd., in order to take up an appointment as manager of a new concern for the manufacture and sale of electric fires and cookers. Personal communications should be addressed to him at 14, Argyll Mansions, Beaufort Street, Chelsea, S.W.

MR. A. R. KIBBLEWHITE, superintendent of the cable department of Callender's Cable and Construction Co., Ltd., Belvedere, has been elected chairman of the Erith Urban Council.

MR. CHARLES BRIGHT delivered an interesting lecture on "Nothing as Usual" at a meeting of the Tonbridge Chamber of Trade held last week.

MR. J. SHEPHERD, electrical assistant in the L.C.C. tramways department, has resigned, and his resignation is to take place as from September next. It was reported at Tuesday's Council meeting that Mr. Shepherd had been in his present position since November, 1910, and had previously held the position of assistant electrical engineer. He has purchased the business of a consulting engineer, which he will take over on July 1st.

COUNCILLOR H. J. BOUCHIER has been appointed chairman of the Hindley Tramways and Electricity Committees.

COUNCILLOR BARNES has been appointed chairman of the Atherton Electricity Committee.

At the annual meeting of the Textile Institute, which is to be held to-day (Friday) in Manchester, SIR WILLIAM MATHER is to be elected president. Past presidents of the Institute have been associated with the cotton and woollen manufacturing industries, and Sir William Mather is the first president selected from the machinery and power branch of the textile industry.

MR. R. S. WADIE, who has been gazetted as Second Lieutenant in the 10th Batt. King's Own Lancaster Regiment, is the son of Mr. W. S. Wadie, electrical engineer, of Chiswick, W.

MR. J. H. DAVIES (late of the Salford and Greenock Corporation electricity department), who has been engaged erecting the electrical plant at Messrs. J. Levinstein & Co.'s Crumpsall Vale Works, nr. Manchester, has been appointed electrician-in-charge at the above works, and commences his duties on May 10th.

Obituary.—The *Morning Post* states that the death is announced of M. HERMANN JENT, managing director of the Agence Telegraphique Suisse since 1902.

NEW COMPANIES REGISTERED.

Electrical Wholesalers' Federation, Ltd. (140,094).—This company was registered on April 27th as a company limited by guarantee, not having a share capital. For the purpose of registration, the number of members is declared not to exceed 100, but the committee may register an increase. Each member is liable for not more than five guineas in the event of winding-up. The objects are: to promote and protect the interests of wholesale dealers in and factors and suppliers of electrical goods and appliances, to promote the consideration and discussion of all questions affecting the wholesale electrical trades, to procure, circulate and supply information (including status information) to obtain the most favourable terms and rates from manufacturers of goods and from railway and shipping companies and other carriers, to encourage the settlement of disputes by arbitration, to act as or nominate arbitrators and umpires, to promote displays of electrical goods, machinery, appliances and fittings, and drawings of the same, at national and international exhibitions, and generally to watch over and protect the interests of persons engaged in selling electrical goods and appliances. The subscribers are:—M. Beales, 12, Norfolk Street, W.C., engineer; F. Pooley, 25, Victoria Street, S.W., engineer; R. W. Smith, 1, Felix Street, S.E., engineer; F. S. Smith, 12, Norfolk Street, W.C., engineer; A. G. Beaver, 118-120, Charing Cross Road, W.C., electrical engineer; P. L. Davies, 1-3, Stanley Street, Liverpool, electrical engineer; G. O. Donovan, 47, Cornwall Street, Birmingham, electrical engineer. All, persons, firms, or companies who are *bona-fide* wholesale dealers in or factors or suppliers of electrical goods and appliances are eligible as members. The management is vested in a committee of not less than seven or more than twelve members. The first members are to be appointed by the subscribers, who themselves constitute a provisional committee. Manager, F. S. Smith. Registered office: Amberley House, Norfolk Street, Strand, W.C.

Ferguson, Pailin and Co., Ltd. (140,150).—This company was registered on May 1st with a capital of £10,000 in £1 shares, to carry on the business of electrical, mechanical, hydraulic and general sanitary, gas and water engineers, switchboard and cabling makers, manufacturers of machinery and apparatus of all kinds, etc. The subscribers (with one share each) are: S. Ferguson, 7, Broadway North, Fairfield, Manchester, electrical engineer; J. Pailin, Glengarry, Queen's Road, Hazel Grove, Ches., buyer and director. Private company. The number of directors is not to be less than three or more than six; the first are S. Ferguson (permanent), J. Pailin, G. Pailin, J. W. Pailin, A. Pailin, and G. Pailin, jun. Qualification, 500 shares. Remuneration, £50 each per annum. Solicitor: R. A. Edgar, 20, Booth Street, Manchester.

CITY NOTES.

Calcutta Electric Supply Corporation, Ltd.

THE directors' report for the year 1914 shows that 15,387,471 units were sold, compared with 14,070,927 units in 1913. The number of houses connected at December 31st last was 8,180, an increase of 583.

Year.	Houses connected.	Units sold.	Gross revenue.	Net revenue.
1911	6,383	10,566,038	£151,905	£95,597
1912	7,030	12,043,398	£173,907	£110,168
1913	7,597	14,070,927	£188,676	£127,092
1914	8,180	15,387,471	£202,455	£140,609

Exchange is calculated at 1s. 4d. per Rupee.

The profits for the year 1914 amount to £140,610, which, with the balance brought forward from 1913 and interest received on money at deposit, makes £148,141. After deducting the interim dividend of 3½ per cent., actual, paid on the ordinary shares in November, 1914; the dividends paid and accrued on the preference shares, and the other items set out in the net revenue account, there remains £102,476. £52,000 is to be placed to the credit of the depreciation and renewals account; £10,000 added to reserve fund; and a final dividend is to be paid on the ordinary shares, for the second half-year, at the rate of 5½ per cent., actual, making 9 per cent. for the year, leaving £11,482 to be carried forward, after providing for the directors' extra remuneration of £2,500, and a bonus of £1,406, payable to the staff in India. The reserve for depreciation and renewals will thus be increased to £188,629 and the reserve fund, with the addition of £2,011 from dividends on investments, will stand at £109,974. The expenditure on capital account last year amounted to £61,443, making the total £1,270,145. The demand for electrical energy continues to increase and the directors have, since the 31st December, 1914, found it necessary to issue additional capital.

STATEMENT OF ELECTRICITY GENERATED, SOLD, ETC.

Total generated in KW.-hours	22,109,714
KW.-hours sold—Public lamps	424,445
By special contract	700,776
By meter for lighting	4,115,484
By meter for power	10,146,766
Total sold	15,387,471
Used on works	5,097,599
Not accounted for	1,624,644
Accounted for	20,485,070
Kw. connected for public lamps	113.3
Max. supply demanded	5,525 KW.

Annual meeting: May 13th.

Cuba Submarine Telegraph Co., Ltd.

THE annual meeting was held on Wednesday at the offices, 58, Old Broad Street, E.C. Mr. GEORGE KEITH, who presided, said it was very satisfactory to note that during the past twelve months the company had managed to hold its position. There was a drop in the receipts for the first six months as compared with the previous year, although the last six months were an improvement on the preceding year's trading. There had been a large increase in their expenditure in connection with the West Indies Station, in consequence of the demand for overtime wages paid to the staff. The cable repairs in shallow water showed a considerable increase over last year, and they had also had the expenses of a new building to replace their old one which was destroyed at Cienfuegos. The total expenditure had amounted to £16,702, as against which the total receipts were £38,245, leaving a balance of £21,542, to which had to be added £7,849 from last year, making a total of £29,391 to be dealt with. £3,000 had been placed to the reserve against loss on investments, £2,500 to the pension fund, and £2,000 added to the general reserve fund, which now stood at £100,000. The directors now declared a further dividend of 5 per cent. on the preference shares, bringing it up to 10 per cent. less income tax, and 5 per cent. on the ordinary shares, free of income tax; this, he regretted, was rather lower than their usual dividend. He thought, in view of the increased rate, it would perhaps be advisable in the future to let the shareholders pay their own income tax, and make an increase in the dividend accordingly. This matter, however, was under consideration. The main cables, continued the Chairman, were all working well. The cable running from Santiago to Cape Cruz, which was broken by an earthquake,

was now being repaired and the expenses of that would come into the current year's accounts. Traffic over the company's cables had been well maintained, and he thought they would look forward to a good year.

Mr. Dryzell seconded the motion, which was carried unanimously.

The Chairman reported that they had received a letter from the British Red Cross Society, and he asked their permission to contribute 100 guineas to that worthy cause. The motion was seconded and carried.

Stratford-on-Avon Electricity Co., Ltd.

The directors report that although there has been a considerable accession of consumers during 1914, the revenue for the latter half shows a slight decline, owing partly to general economy in lighting and partly to the closing of one of the picture houses where a considerable amount of current was taken during the corresponding period of the previous year. The expenditure was higher principally in consequence of a general rise in all the requirements of the company. The directors might have recommended a small dividend, but consider it desirable, in face of the present outlook, to strengthen the reserve and slightly increase the amount to be carried forward. After writing off £200 to reserve and depreciation account and building sinking fund, making it £802, the available balance is £189. Directors' fees absorb £50, and £139 is to be carried forward.

	1912.	1913.	1914.
Units generated	192,479	190,582	210,825
Units sold	131,777	143,708	142,790
Lighting	79,940	78,044	74,451
Power	40,895	55,217	56,370
Heating	10,984	10,447	11,969
Used on works	48,000	36,874	21,114
Unaccounted for	12,661	10,000	46,921
8-c.p. lamps connected	12,150	15,852	16,352
Maximum load in kw.	120	100	90
Average price obtained	3.30d.	3.37d.	3.26d.

British Thomson-Houston Co., Ltd.

The directors, in their report for 1914, state that prior to the outbreak of the war the company was making excellent progress in all its departments, but its business was seriously disturbed in many directions in August and September last. In a comparatively short time satisfactory re-adjustments were made to cope with the new conditions with the idea of doing as much work as possible to fill orders to meet, directly or indirectly, the requirements of the Government, and at the same time carry out so far as reasonably possible obligations to other customers. Over 1,000 employés have joined the Colours, being a large percentage of those eligible for military service. The loss of this number of employés, and the difficulty found in filling their places, even partially, has been a source of considerable embarrassment, but those who have remained have loyally supported the efforts of the management in all directions. For months past the company has been manufacturing munitions of war at its various factories, and has bought a large number of machine tools for this purpose. It is particularly gratifying to note that notwithstanding the disturbed financial conditions, collections were excellent during the whole of 1914; practically no customers availed themselves of the privileges afforded by the Moratorium, and losses from bad debts were so small as to be inappreciable. This conditions of affairs under the circumstances was remarkable, and indicated the strong financial condition of the country.

The buildings and machinery of the company had been maintained in first-class condition during the year, and all buildings under construction and authorised at the date of the last annual report had been completed and were now in use.

At the end of December, due to the number of employés joining the Colours who were familiar with the stocks of finished apparatus and work in progress, it was physically impossible, within a reasonable time, to take an actual inventory of the Rugby Main Factory, so that in making up the accounts for the year the directors have relied upon the book figures and, although in the past years the inventory figures have shown a considerable increase over the book figures, and the directors have reason to believe the percentage of increase would have been equalled, if not exceeded, for the year 1914, they have taken no profit on this account, but have allowed the book figures to stand. In the Lamp Factory at Rugby, in the factories at Coventry and Willesden, and in all branch offices, a complete inventory has been taken in the usual way. The profits for the year, after deducting all expenses and charges other than interest on debentures and loans, are £130,868, plus £12,944 brought forward, making £143,812. The amount paid for interest on debentures and loans during the year was £56,705, leaving a net profit of £87,107. Of this amount the directors have thought best to appropriate for depreciations £73,309, so as to still further strengthen the company's position, and carry forward £13,798 to new account. Heretofore the first two items on the credit side of the company's balance sheet have been "goodwill, patents and licences," and "investment in Patent Owning Company." The second item is of substantially the same character as the first, and as the company owns all the shares in the "Patent Owning Company," the directors have decided to consolidate these items, and hereafter they will jointly appear under the first title only. Under the terms of the Trust Deed securing the issue of the company's debentures, the Company has this year to pay to the trustees the sum of £4,452 to be applied by them in redeeming debentures at 105 per cent. by drawings. Since the closing of the books debentures of the par value of £4,240 have been redeemed, making the total par value of debentures retired to date £30,025, and leaving a net amount outstanding at the date of this report of £181,975. The amount outstanding at the 31st December, 1914, was £186,215. The directors have followed their usual practice in making reserves to cover risks in connection with bad debts, and other contingencies. In addition to the amount shown in the profit and loss account, the directors have applied the reserve heretofore made, in writing down the debentures and shares held by the company, to the value now shown. During the year Mr. F. Fraser, secretary to the company, was appointed a director to fill an existing vacancy.

Annual meeting, May 12th.

Eastern Telegraph Co., Ltd.

The directors report that for 1914 the revenue amounted to £1,645,741, from which is deducted £621,866 for the ordinary expenses, and £164,583 for expenditure relating to maintenance of cables, sundry differences in exchange, income tax payable abroad, and interest on temporary loans, leaving £859,293, plus £25,687 brought forward, making a total available balance of £884,979. After providing for income tax payable in England, interest on mortgage debenture stock, and dividends on the preference stock, which in all absorb £177,237, there remains £707,742, out of which the directors have placed £390,000 to the general reserve fund, £5,000 to the insurance of goods in transit fund, and have paid three interim dividends of 1¼ per cent. each on the ordinary stock, aggregating £150,000. A final dividend on the ordinary stock of 1¼ per cent. is recommended and a bonus of 2 per cent., amounting together to £130,000, both payable on May 12th, free of income tax, and making, with the three previous payments on account, a total distribution of 7 per cent. for the year. It is proposed to carry forward £32,742. The general reserve fund has been charged with £273,973 in respect of new cables and other special expenditure, and after crediting the £390,000 referred to above, the net addition to the fund for the year is £116,027.

Annual meeting: May 12th.

Dudley, Stourbridge and District Electric Traction Co., Ltd.

The annual meeting was held on Monday at the offices of the Electrical Federation, Kingsway. Mr. S. R. Blundstone (chairman) presided, and on his formal motion the report was adopted. This statement shows that the total revenue for 1914 was £50,780, compared with £52,843 for the preceding year. After payment of all expenses properly chargeable to revenue, interest on debenture stock, and placing £2,500 to the renewals fund, there was a surplus, including £75 brought forward, of £7,351. After putting to reserve £500, paying a dividend of 5 per cent. on the preference shares requiring £5,000, and a dividend on the ordinary shares at 1 per cent. requiring £1,000, £851 is to be carried forward. The company has continued to benefit during the past year from the operation of its tramways as part of the system worked by the Birmingham and Midland Tramways Joint Committee, and the arrangement has, therefore, been continued.

Wolverhampton District Electric Tramways, Ltd.

Mr. S. R. Blundstone (Chairman) presided on Monday at the offices of the Electrical Federation, Kingsway, over the annual meeting. The proceedings were purely formal, and on the motion of the Chairman the report was adopted. This statement showed that during 1914 the total revenue was £28,359. After deducting all expenses chargeable to revenue, including debenture interest, repairs and maintenance, and providing £2,000 for the renewals, there remained a profit of £2,350, plus £134 brought forward. After placing to reserve £500 and paying a dividend on ordinary shares at the rate of 1 per cent. per annum, £386 is carried forward. The arrangement with the other companies operating tramways in the district for joint working under the management of the Birmingham and Midland Tramways Joint Committee has proved satisfactory, and has been renewed.

West African Telegraph Co., Ltd.

The revenue for 1914 amounted to £55,523, from which is deducted £17,633 for the ordinary expenses, and £8,536 for expenditure relating to maintenance of cables, sundry differences in exchange, and income tax abroad, leaving a balance of £29,354, plus £66 brought forward, making a total available balance of £29,420. £543 has been provided for income tax, £19,000 has been transferred to general reserve fund, and an interim dividend of 2 per cent. (free of income tax), absorbing £4,622, was paid on December 1st last. The directors now recommend a final dividend of 2 per cent. (free of income tax), payable on and after May 13th, making, with the interim distribution, 4 per cent. for the year, £633 being carried forward. Sir Albert J. Leppoc Cappel, K.C.I.E., has been appointed to a seat on the board, in the place of the late Mr. Robert Kaye Gray.

Annual meeting: May 12th.

Johnson & Phillips, Ltd.

Mr. Robert W. Blackwell presided on Thursday last week over the annual general meeting, held at Winchester House, E.C. He said that the accounts showed a continued improvement. The 1914 trading profit, after the provision of £7,529 for maintenance of buildings and plant, stood at £37,119; £3,944 better than in 1913. He could repeat what he said at previous meetings—that the business was improving steadily in extent and value and would, in his humble opinion, continue to so improve. The balance sheet demonstrated that the company occupied a sound and strong financial position. They had a large amount of work in progress. The stock-in-trade had been taken on safe and conservative lines. Every department of the business showed a profit on the year's working. On December 31st, 1914, sundry creditors and bills stood at £100,063, against which they had sundry debtors amounting to £119,518, as against £94,311 and £107,855 respectively at the end of 1913. The stock-in-trade and work in progress represented £154,988; £4,558 less than the similar figure in 1913. Investments amounted to £2,368—patents, licences, etc., to £10,300—and cash in hand £15,509. During 1914 they spent on additions to buildings and plant £16,933 and set aside for depreciation £8,000. At the date of the balance sheet, the original issue of first debentures had been decreased from £175,000 to £118,136. The board recommended the payment of a dividend at the rate of 5 per cent. per annum on the 175,000 ordinary £1 shares. That dividend would take up £8,750, and would leave to be carried forward £15,545. The board did not consider that it would be justifiable to declare a larger dividend under existing conditions. It was unnecessary for him to point out how all-important it was to preserve a strong financial position at this juncture. He looked forward to the future of Johnson & Phillips with every confidence. Its manufacturing plant was well maintained and had been vastly improved during the past few years. Its shops had been, and were, well employed, and he could see no reason why its turnover and profits should not increase steadily, especially when happier times came to the country at large.

Mr. T. Dence seconded the motion.

The Chairman, in reply to questions, said he did not think the company had made investments in plant with a view solely to war business, and therefore he did not think at the end of the war they would be in possession of any machinery of doubtful value. They had made some additions and alterations and done what was necessary to meet the demands of the Government, but he was not aware of anything in the factory which would depreciate in value should the war stop to-morrow. Such new machinery as they had put in was being used partially for Government and partially for private contracts and was on the lines of the proper expansion of their business. The war had not benefited them, as the amount of work which they had offered them prior to the outbreak of hostilities would have put as great a demand upon the plant and would have resulted in practically as large a profit as anything they might look forward to obtaining from war business. In no sense did the prosperity of the company depend upon the continuance of the war—in fact they would like to see it over as speedily as possible.

The report was adopted.

Indo-European Telegraph Co., Ltd.

Mr. J. Herbert Tritton presided on April 29th at the offices, 18, Old Broad Street, E.C., over the annual meeting. He said that the outbreak of war had an immediate effect upon all telegraphic communications, especially those connecting Germany with the Allied countries. The Indo route to India and beyond was totally interrupted in Germany on July 31st without notice and before the declaration of war. Later the cable connecting Odessa with Constantinople was disconnected at both ends. These interruptions had necessarily curtailed the usefulness of the company's system, restricting the working to the transmission of traffic between Russia and places east of that country. It might have caused the shareholders some surprise to see that the company's revenue had not diminished, although their route had been interrupted since July 31st, but some of them might remember that in the early days the company entered into reciprocal working arrangements with the Eastern and Associated Telegraph Companies. These arrangements provided for the maintenance of revenue of the different parties to the agreements for a specific period despite the fact that the revenue contributed by one of those parties might be reduced or entirely stopped. They had at times heard complaints made of such mutual working arrangements, but the position of the company might have been serious had no such arrangements been entered into, and they thought their value had been amply demonstrated in this case—indeed they had proved a necessary safeguard. They had already approached the British Government on the subject of the future of the company, and had received an assurance from the Government that facilities would be given to the company for the re-establishment of the Indo route. He did not propose to go further into the question of the route that would eventually be decided upon by the company, and must ask the shareholders to be satisfied with the statement that the matter was receiving the serious attention of the directors and that steps were being taken to ensure the continuity of the company's communications. The company's lines in Russia had been placed entirely at the disposal of the Russian Government, and they were glad to know that the Russian military authorities were making very considerable use of them. The company's line passed through a part, a considerable part, of the area where constant fighting was taking place and through the town of Warsaw. Since the war began, the London staff had been employed by the Eastern Co. in London. That company had suffered from severe pressure owing, amongst other causes, to the fact that the Indian and Trans-Indian traffic had been carried by their cables, and they were glad to assist them by the loan of their experienced operators. It was satisfactory to learn from Sir John Pender, the managing director of the Eastern Telegraph Co., that they had rendered valuable services. The directors had voted £250 to the Prince of Wales's Fund as a first contribution. They had also made a contribution to the Red Cross organisation inaugurated by the Director-General of Telegraphs at Petrograd in connection with his department, and had received a graceful letter of acknowledgment from the Director-General. The war, of course, put a stop to practically all their wireless experimenting, and their large station in France was taken over by the French Government, whilst their small station in this country was taken over by their own Government. The directors proposed to set aside £10,000 towards wireless and other technical development. They were hoping to make experiments in the course of a few weeks with a wireless transmitting set of comparatively small power coupled with reception by an improved Orling wireless relay, and they had every reason to believe that the experiments would give satisfactory results. The restoration of the company's route might very likely necessitate some experimental work, and the directors thought it prudent to set aside the sum mentioned in the report to meet the expenditure that would be incurred in making such experiments and assuring their position. The directors had decided that £25,000 be set aside towards possible downward fluctuations in the investments. Although the Government had fixed minimum prices it must not be assumed that those prices were effective or would hold when the minimum had been taken off. In this they were making what might prove to be an over-provision, but in this case the company's reserves would have been strengthened. The financial side of the report called for little comment. The revenue for 1914 amounted to £189,383, showing an increase of £16,851, and the net result showed a balance carried to profit and loss of £100,988. This was the first occasion in the history of the company upon which their net revenue had reached £100,000. The expenses were £88,395, as compared with £91,441 for 1913. The decrease was accounted for by the interruption of their communications, certain items of expenditure having been lessened owing to this fact. The carry-forward this year was £20,592, as against £6,461 last year. The directors were of opinion that a larger carry-forward was desirable at the present time. The principal, if not the only, item of interest in the balance sheet was the entry of £50,000 war loan, for which they were glad to be able to subscribe. The resolution amending Article 90 of the Articles of Association, recommended for acceptance, was rendered necessary by the exclusion of the non-Government German director from the directorate.

Sir W. B. Brooke seconded the motion and it was carried.

In reply to a shareholder, the Chairman said the company were giving full pay to those of their staff who were serving with the Colours.

Weston-super-Mare and District Electric Supply Co., Ltd.

The annual meeting was held on April 29th, at Electrical Federation Offices, Kingsway, W.C. Mr. Geo. J. Somerville, who presided, remarked that in the electricity supply section they had had an increase in income, in spite of their having supplied less current to the traction section. Owing to the war that section of the business had not been so remunerative as in the previous year, but that was a cause quite outside their control.

Mr. C. G. Tegetmeier seconded the adoption of the report, and it was carried.

The report showed that the total capital expenditure at December 31st last amounted to £132,278. The accounts for the year showed a credit balance of £5,274 from electricity supply, £3,887 from traction, and £90 from sundry receipts, making £9,251. Deducting administration and general expenses £1,672, debenture and other interest £2,222, and placing £1,000 to renewals account, there is a balance of £4,356, plus £403 brought forward. There is to be placed to reserve £500, a dividend on the 6 per cent. preference shares absorbs £2,400, a dividend at the rate of 3 per cent. on the ordinary shares requires £1,050, and £809 is to be carried forward. The installations connected to the mains at December 31st, 1914 (excluding the traction section) represented the equivalent of 40,489 lamps of 8 c.p., an increase of 3,364. The number of consumers during the year increased from 505 to 597. The total revenue advanced by £460, and the expenses by £328, the net result being an improvement of £132. The gross receipts from the traction section were £7,091, a decrease of £1,646, due to the war. The expenses amounted to £3,204, leaving £3,887, a decrease of £1,377 compared with 1913.

Oriental Telephone and Electric Co., Ltd.

Mr. H. Johnstone Grewing presided over the annual meeting, held on April 28th, at the Great Eastern Hotel, E.C. He first alluded to the recent death of Mr. B. St. John Akers, who was the oldest shareholder in the company and served on the board for over 30 years. The vacancy had been filled by the election to the board of Mr. Ness. As to the addition of other directors to the board, it was suggested that two be left in abeyance for the moment, because, as the shareholders had been advised by various circulars, proposals would be made as early as possible, some of which effected a possible re-arrangement of the board. As to the accounts, in spite of the great events which had taken place since they last met, the progress of their branches had been maintained. It would be idle to pretend that the war had not affected them, as it had everybody else, but they had not been affected to the extent that many undertakings had. At the beginning of August there was a slump everywhere, but as soon as the first shock had passed, things recovered, and he was glad to say there was an increase in all their branches, although not so great as they might have hoped for in normal times. In the case of the China Co., there was a net increase in the revenue for 1914 of £1,619, and the number of new lines added to the system was 235. The Bengal Co. showed an increase of £3,143 in net revenue, and 358 new lines had been added. The Bombay Co. showed an increase of £2,403 in revenue and 199 lines. The dividends paid by the two former companies were the same as last year, viz., 5 per cent. for the China Co. and 7 per cent. for the Bengal Co., and in the case of the China Co. it would have been possible to have increased the dividend, but they thought perhaps under the present conditions it would be better to keep to the old figure. The Bombay Co. had felt itself able to increase its dividend to 16 per cent. He might mention in connection with the Bengal and Bombay Companies as to the remark in the auditors' certificate as to the valuation of the investments in subsidiary companies, that the latest quotation for the Bengal Co.'s 100 rupee shares was 125 rupees, and for the Bombay Co.'s 25 rupee shares 83 rupees. As regarded the Egyptian Co., as they knew Egypt had been more affected, perhaps, than any of the Eastern agencies by the war, and, in addition, for the last seven or eight years it had had a series of misfortunes. First there was the financial crisis in 1907, and then came the Turkish-Italian war, and next the Balkan war, and now the European war. Anyone acquainted with the population of Egypt, consisting as it did so largely of Italians, Greeks, French, Turks and Arabs, would understand that these events affected Egypt much more than they would any of their exchanges further East. To have been able to maintain their position under these circumstances would have been an achievement of no small merit, but in addition they had been able to show some slight advance on the previous year, which must be considered as particularly satisfactory under the circumstances and highly creditable to their officials and staff. This applied with equal force to their officials and staff further East. At most, if not all, of their exchanges, very considerable demands had been made upon their services in connection with telephonic communication, both by the military and civil authorities, and the company had succeeded in meeting their requirements in every case. In fact, their managers had been complimented upon the assistance they had been able to offer.

Mr. Hibbert formally seconded the motion, and said the shareholders knew that another meeting would take place shortly at which the action taken by a shareholders' committee would be dealt with.

Sir Fortescue Flannery expressed great surprise that the motion should have been put before the meeting without some further explanation of what was a matter of public knowledge. He referred to the action taken by Mr. Bailey before Mr. Justice Astbury first, and afterwards before the Court of Appeal, for the restitution of large sums of money by the directors to the shareholders. The result of both actions was in favour of Mr. Bailey. If he understood the circulars which had been sent round to the shareholders, there were at present negotiations going on between the directors and Mr. Bailey and his committee for a settlement of the matter with the object of avoiding further litigation. That settlement, he understood, included the restitution of many thousands of pounds by some of the directors—money which they had actually drawn and received, and which was now in their possession. If the meeting carried the report which contained the paragraph as to the re-election of Mr. T. Lloyd and Mr. H. J. Grewing to the board, he ventured to think the shareholders would be stultifying themselves. If the meeting was going to be adjourned for the purpose of receiving Mr. Bailey's report he saw no useful purpose which was going to be served by passing the report that day.

Mr. Skelding said he had not the least notion where they stood. All he knew was that a certain Mr. Bailey, with whom he was not acquainted, had agitated in conjunction with Mr. Ness, who also he was ignorant of. He was given to understand by a member of the board that the principal object of the agitation was to oust the old board, and if that was so, he congratulated Mr. Ness on having found a place on the board. That congratulation was coupled with a certain amount of sympathy with the gentlemen on the board in having to put their hands in their pockets for the sum of £53,000. Mr. Skelding proceeded to refer to a circular sent round, in which the board suggested that if the Court had been in real possession of the facts, they would not have made such scathing denunciations against the directors. Apparently they blamed counsel or the solicitors, and if so, why was it that the solicitors still remained with the company? The fact was that the shareholders had been left in the dark and had been told that the board would use the proxies of those silly people who sent proxies. The company was flourishing, and why should the board not be content to join in the advantages of a flourishing company without grasping for huge sums of money like he had referred to, instead of letting the shareholders know exactly what was being done?

A shareholder asked whether if the report was not adopted that day, it would mean that a dividend could not be paid.

The Chairman said that was so.

After further discussion regarding the adjournment of the meeting, the Chairman said that negotiations of an informal character had taken place with the Committee, and it was the intention to have called a meeting and to lay the proposal before the shareholders for an amicable settlement of the matter. For various reasons the meeting could not be called, and the death of Mr. St. John Akers had placed a further obstacle in the way. But he could assure them that nothing which could take place at that meeting would prejudice what might be arranged later on. Mr. Lloyd did not intend to offer himself for re-election, and with regard to himself, his re-election would depend entirely upon the shareholders, and if it was the wish that he should retire in favour of someone else he would do so.

Mr. Ness said he was one of the Committee to meet the directors to try and arrive at an amicable settlement. It was a pity Mr. Bailey did not issue a circular informing the shareholders of what had been done, but such a circular was actually drafted and would have been issued but for Mr. Akers's death. After the hearing of the case in the High Courts a committee of shareholders met together and thought it would be in the interests of the company to have some conferences with the directors, and this had been done. Eventually they succeeded in coming to a conditional understanding. Any compromise was, of course, conditional as the committee had no power to bind the shareholders. His own impression was that when they knew the terms, the shareholders would be satisfied. It consisted of three points: The first was a very substantial refund on the part of directors of moneys they had received. (A voice: "Why not all?") It was not possible to get everything one wanted, and if they had insisted on getting too much they would have been landed with litigation in the House of Lords. Put briefly, the compromise included a refund equivalent to a 12 per cent. deferred dividend which would be paid immediately on the conclusion of the transaction. Then three new directors were to be appointed, and there was to be a revision of the terms of remuneration and a fixed sum paid instead of a percentage of profits.

Answering a question as to the present terms of remuneration, the Chairman said the five directors of the Oriental Co. got £300 each, the four directors of the Egyptian Co. £200 each, and the three directors of the China Co. £175 each. This was exclusive of commission on profit in the Egyptian Co., which amounted to about £500 for each director.

The Solicitor endorsed the Chairman's statement that the passing of the report would not prejudice the shareholders' action at the meeting which was to be called. The liability of the directors did not arise as directors of the Oriental Co., but as directors of the Egyptian Co. Everything they received as directors of the Oriental Co. was perfectly in order. There was still the House of Lords, who might say that the money should not be paid.

The report was adopted by 20 votes to 13. Votes of thanks were passed to the Chairman and staff, and to Mr. Bailey.

Kidderminster and District Electric Lighting and Traction Co., Ltd.

Mr. J. A. Lycett (Chairman) presided on Monday, at the Electrical Federation Offices, Kingsway, over the annual meeting. He formally proposed the adoption of the report, which was seconded by Mr. S. E. Garcke and agreed to. The report stated that the total capital expenditure at December, 1914, on buildings and plant, etc., for electric supply amounted to £57,723. The net receipts of the lighting department were £4,261. Adding dividends receivable, £1,955, and the amount brought forward, £204, there is a total of £6,421. After deducting administration and general expenses, reserve for doubtful debts, interest on temporary loans and debenture interest, there remains £2,468, from which there is to be put to reserve £750; dividend on cum. pref. shares for the year absorbs £1,500, leaving to be carried forward £218. The company has sold its motor omnibus interests to the Worcestershire Transport Co., and now holds 11,109 £1 shares (fully paid) out of a total of 19,347 shares issued by that company. The report of the Kidderminster and Stourport Electric Tramway Co. for 1914 shows that no additional expenditure on capital account was incurred. The profit on working, after providing for renewals, is £1,964, plus £129 brought forward, leaving an available balance of £2,093. Out of this there has been applied to reserve £500, and to dividend at the rate of 2½ per cent. £1,430, carrying forward £163. The directors regret that owing to pressure of other business, Mr. C. Shirreff Hilton has resigned his seat on the board. Mr. Lycett has been appointed chairman.

Lisbon Electric Tramways, Ltd.

The directors report that the result of the company's operations for 1914, after deducting interest and amortisation due on the debentures of the "Companhia Carris de Ferro de Lisboa" and after the payment of £25,610 for interest on and redemption of the debentures of this company and also the payment of London office expenses and directors' remuneration, shows a net profit of £84,709, plus £1,749 brought forward. £15,000 has been placed to the credit of depreciation reserve, £5,000 to exchange reserve, and £19,013 formerly standing to the credit of "premium on ordinary share capital," has also been transferred to depreciation reserve to adjust the decrease in this year's appropriation from the profits. Out of the available balance of £66,458, the usual 6 per cent. preference dividend, amounting to £25,533, has been paid. On November 12th, 1914, the directors paid on the ordinary share capital an interim dividend of 3 per cent. net, amounting to £19,021, and they now recommend a final dividend at the same rate, making 6 per cent. net for 1914. The balance of £2,883 remaining to the credit of profit and loss account has been carried forward to next year's account. The tramways have carried 63,758,037 passengers, earning Es. 1,938,210 $79,3, as compared with 58,840,923 passengers, earning Es. 1,861,056 $93,9 in 1913. The traffic, therefore, has been more than maintained, but the increased cost of supplies, especially coal, and the falling off in the average rate of exchange from 46.199d. to 43.43d., both of which adverse factors were brought about by the disturbing conditions caused by the war, have resulted in a diminution of the profit to the extent of nearly £20,000. The extension of the power plant was completed during the year, and is in satisfactory operation. One of the most important of the Ascensores lines was electrified and re-opened to traffic during the period under review, and the remainder of the system will be completed in the course of the current year. No further progress has been made in the negotiations with the Municipality mentioned in last year's report. The board regret the death of Mr. S. W. Jameson, who was secretary of the company since its inception. Mr. F. Haines, who was acting secretary, has been appointed his successor. The board record their appreciation of the services rendered to the company by the members of the local board in Lisbon, by Mr. A. O. Kolkhorst, the general manager, and by the entire staff.

Annual meeting: May 12th.

Craigpark Electric Cable Co., Ltd.—For the year ended March 31st, 1915, the accounts show a net profit of £8,906, plus £1,391 brought forward, making £10,297. There is put to depreciation off buildings and machinery £2,500, to reserve account £1,000, to dividend on 6 per cent. preference shares £2,850, to dividend on 37,500 ordinary shares, at 6 per cent., for the year £2,250, leaving to be carried forward (subject to payment of directors' fees) £1,697. Business during the year was satisfactory, although the output of the company suffered somewhat from the dislocation inseparable from the war. The value of orders on hand at the moment is considerable, and the prospects for the coming year are good. The directors regret to report the death of Mr. William Henri Luther, who was appointed a director only last year. Annual meeting, May 12th.

Chloride Electrical Storage Co., Ltd.—A dividend of 10 per cent. on the ordinary shares is recommended for the year.

Auckland Electric Tramways Co., Ltd.—An interim dividend of 7d. per share, less income-tax, on the ordinary shares is announced.

Submarine Cables Trust, Ltd.—The directors report that the revenue for the year ended April 15th amounted to £25,175, and the expenses to £1,359, leaving £23,816, plus £30 brought forward. After providing £16,236 to meet payment of the coupons, £7,560 has been transferred to the redemption fund, leaving £50 to be carried forward.

Alderley and Wilmslow Electric Supply, Ltd.—The annual meeting was held on April 27th. The directors' report, to which brief reference was made last week, recorded the death of a director of long standing in the person of Mr. John Royle. Mr. H. S. Hadwen has been elected to the vacancy.

Anglo-American Telegraph Co., Ltd.—The directors' report for the year ended March 31st, 1915, states that the dividends paid absorbed altogether £262,500, being the rent paid by the Western Union Telegraph Co. for the year, equal to 3¾ per cent. on the ordinary stock, 6 per cent. on the preferred stock, and 1½ per cent. on the deferred stock. The balance at credit of revenue account (£71,250) includes £5,625 interest received, and the balance of £65,625 is available for the payment of dividends for the quarter to March 31st, 1915.

Tramways and General Works Co., Ltd.—A dividend of 6¼d. per share, less income-tax, for the year is recommended, carrying £207 forward.

Yorkshire (Woollen District) Tramways, Ltd.—The revenue for 1914 amounted to £65,385, an increase of £2,876. After deducting all expenses chargeable to revenue, including repairs and maintenance, payments to local authorities under agreements, debenture and other interest, and setting aside £4,500 to renewals fund, there remains £9,696, plus £1,891 brought forward. There is to be put to reserve fund £2,000, to dividend at the rate of 3½ per cent. per annum on the ordinary shares £7,001, carrying forward £2,586.

Chiswick Electricity Supply Corporation, Ltd.—The directors report a capital expenditure of £4,357 during 1914. The profits, after paying sinking fund premium and trustees' fees, were £8,386. Interest on first mortgage debenture stock amounting to £3,600 has been paid, leaving £4,786 to the credit of the net revenue account. A dividend at the rate of 6 per cent. for the year is recommended, carrying £1,018 to depreciation reserve fund account.

Eastern Extension, Australasia and China Telegraph Co., Ltd.—The gross receipts for the year 1914 amounted to £819,583, against £738,129 for the previous year. The working expenses, including £61,174 for maintenance of cables, absorb £364,978, against £354,864 for the previous year, leaving a balance of £454,604. From this is deducted £13,754 for income-tax payable in England, and £30,096 for interest on debenture stock, leaving £410,753 as the net profit, plus £30,616 brought forward, making £441,370. Three interim dividends of 1¼ per cent. each have been paid for the year, and it is now proposed to distribute a final dividend of a like amount on June 12th, making a total dividend of 5 per cent. It is also proposed to pay a bonus of 4s. per share, or 2 per cent., making a total distribution of 7 per cent. for the year. £200,000 has been transferred to the general reserve fund, and £31,370 is carried forward. The balance of cost, amounting to £194,078, of the Penang-Singapore-Hong-Kong cables has been charged against the general reserve fund. £35,443 has also been charged against the fund for partial cable renewals carried out during the year, together with the loss amounting to £43,901 incurred on the sale of investments.

Buenos Ayres Port and City Tramways, Ltd.—In a circular issued to holders of 6 per cent. first mortgage debenture stock and 6 per cent. extension first mortgage bonds, it is stated that the committee representing both classes of debenture-holders consider that the best interests of the debenture-holders would be served by the adoption of a scheme for consolidating and re-arranging the funded debt, thereby avoiding difficult questions which would inevitably arise if receivers were appointed. The trustees concur in this decision. It was anticipated that it would have been possible to submit a scheme of reorganisation before this date, but, unfortunately, delays have occurred, through technical difficulties, in dealing with matters connected with the floating debt of the company, which it is hoped may shortly be overcome.

Calcutta Electric Supply Corporation, Ltd.—The number of units sold to consumers during the four weeks ended February 26th amounted to 990,763, compared with 1,080,419 in the corresponding four weeks of 1914. For the four weeks to March 26th the figures were 1,212,991 for 1915, and 1,220,009 for 1914. It is stated that general slackness of trade in Calcutta, owing to the war, has caused the above decreases.

South Wales Electrical Power Distribution Co.—The report states (says the *Financier*) that as, under the working arrangement with the Treforest Electrical Consumers' Co., Ltd., the whole of the working expenses in connection with the undertaking are now borne by that company, there is, for the time being, no revenue account to be submitted. Notwithstanding the dislocation of trade during the last five months of the year, the business of the company shows an increase, the units sold amounting to 26,510,198, as compared with 25,812,031 sold in 1913, an increase of 698,167 units. The surplus, after payment of all working expenses and interest on prior lien debenture stock, and making due provision for depreciation of new plant, amounts to £5,347, as compared with £2,915, the surplus for 1913, an increase of £2,431. The accumulated profits are now sufficient to deal with the indebtedness of £13,500 due to certain members of the Treforest Co. for overcharges, as explained in previous reports. The continued expansion of the company's business necessitates the provision of further capital, for which the requisite steps are now being taken by the directors under the borrowing powers already possessed by the company, and, subject to these and incidental arrangements being accomplished, the directors confidently look forward to being able to make a payment in respect of interest on the original debenture stock in the course of the coming year.

Costa Rica Light and Traction Co., Ltd.—At a meeting of the holders of the 6 per cent. prior lien debentures, held on Wednesday, resolutions were, according to the *Financial Times*, to be submitted to release the company from liability to make payments to the sinking fund until May 15th next following the expiration of one year after the termination of the present European war.

Reduction of Capital.—Gell Telegraphic Appliances Syndicate, Ltd., and Reduced.—A petition for the confirmation of the reduction of capital from £40,000 to £20,000 has been presented, and will be heard on May 11th.

STOCKS AND SHARES.

TUESDAY EVENING.

A good many of the markets in the Stock Exchange have come to something like a pause, investment and speculative investment both being checked by the recent news from France, and, still more, by that from Russia. Although so neatly wrapped up in the official dispatches, the advance established by the Germans has not been ignored by those closely following the sphere of operations in the Western theatre; and that the enemy should have progressed at all, just at the time when the Allies were expected to make a sweeping forward movement, has caused a little disappointment to those who profess to see in it something more than the mere ebb and flow of events connected with a great war. As regards the Russian operations, the German tales are, of course, not credited without confirmation from Petrograd, but it is thought that our Allies may have suffered a setback.

Moreover, the grave statements with reference to labour difficulties which have been contributed by Admiral Jellicoe, Mr. Lloyd George, the Director of Transports, and others combine to produce a feeling of uneasiness in the minds of the investing public. Money itself remains almost ridiculously easy—the result, principally, of the disposition of capitalists, large and small, to keep their cash resources liquid rather than employ them in Stock Exchange channels for the time being.

The Home Railway market continues to give way, in consequence of the labour troubles. Principally, the demands made by the Miners' Federation for an increase of 20 per cent. in wages are responsible for the refusal of the public to put money or faith into the leading industry of the country. It is true enough that the floating supply of stock is comparatively small—a factor which will assume correct proportions as soon as any attempt is made to buy Home Railway stocks. Just at present, however, such attempts are conspicuous only by their absence; and the result is reflected in what dealers in the market euphoniously call a softening process, in contradistinction to the "hardening" of values which might have been expected to take place at the present time, had it not been for the labour unrest.

Metropolitans and Districts drooped with the rest. Central Londons keep steady, and there are one or two buyers about of the Company's ordinary assented stock. The Underground Electric group as a whole, apart from the two issues mentioned, maintains its ground with more tenacity than is shown by the Steam stocks. There is little setback in the prices of debentures and preferences—a testimony to the determination of investors to retain their holdings for better times, rather than evidence of demand to-day.

The Telegraph market is one of the firmest in the electrical departments. Cuba preference rose 10s. Great Northerns at 32 are £2 up, thanks to the increase in the dividend. Globe preference eased off a little. Indo-Europeans at 56 are £1 higher, very little inquiry sufficing to put up the price. Anglo-American deferred slipped back ¼ on a few profit-taking sales by those who bought the stock some weeks back at a lower figure and who consider themselves fortunate in being able to take a quick turn in war time, but the preferred regained all the 1½ per cent. dividend deducted last week from the price. Eastern Extensions are firm on the issue of what, in the circumstances, must be regarded as an excellent report.

Telephone shares are also wanted. There are rises this week in Chilis, United River Plate, and Orientals. New York Telephone 4½ per cents. are 98, ex the half-yearly interest; allowing for deduction of tax, the movement on the week is practically nil. Marconis remain at 1¾, Canadians at 5s., Americans at 10s. 6d. There is nothing much to induce purchases of Marconis while other markets are dull, but in any breath of revival the optimists who profess to see the shares at £2 are quite likely to be justified. The Telegraph Manufacturing group is also good. Telegraph Constructions at 37½ have gained a fraction; Callender's preference improved to 5, their par value; British Insulated at 11½ are easier to sell than they are to buy.

Brazil Tractions are lower at 55½, which, allowing for the dividend, makes a fall of a point on the week. The shares fell, in company with most of the active securities round the House, on Tuesday (to-day), when the effect of the Russian news was to make most things weaker. Mexicans are fairly steady, and Anglo-Argentine Tramways 1st preference continue to improve. The Buenos Aires Port and City Tramways Co. has circularised its bondholders, through the committee, to the effect that a new scheme of re-organisation is under consideration. There is an idea that a fresh first charge debenture stock will be issued, and possibly income bonds as well, in exchange for the existing bonds.

The Home Electricity list is very quiet. County of Londons stand at ½ harder at 11¼, but apart from this there is not a quotable change in the catalogue. Nor is the Miscellaneous list much different, from the point of view of movements in prices. Castner-Kellners are good at 3⅛, and there was a slight recovery in Edison & Swan partly-paid shares. The Chiswick Electricity Supply Corporation proposes to pay a dividend on the shares at the rate of 6 per cent. for the year.

East London Railway ordinary stock has been changing hands fairly frequently about 4½, and this has caused a recrudescence of some of those rumours with which we grew so familiar some years ago, as to the company being taken over by one or other of its bigger brethren.

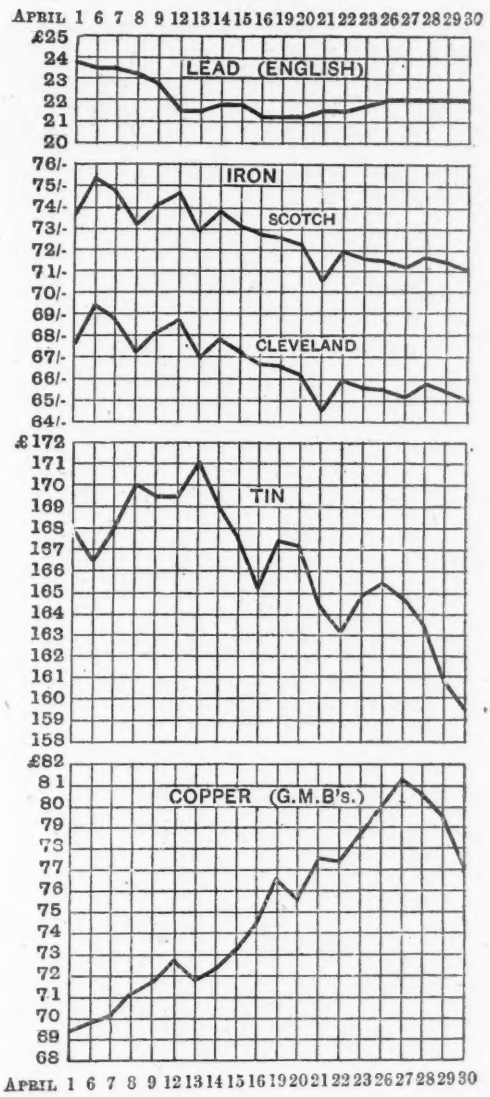
Rubber shares have weakened, on profit-taking by those who thought, justifiably enough, that prices had been run up rather rapidly, and that a time of reaction was due. The price of the raw material, after giving way for several consecutive days, took a turn for the better and is on the mend again. Armament shares are also droopy, mainly on account of the Government's decision to curtail war profits and on the serious state of affairs which is said to prevail amongst a section of the men employed upon the work of turning out munitions of war. The Budget is not likely to affect the stock markets in any material manner.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	May 4, 1915.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.				
Brompton Ordinary	10	8½	—	£6 1 8
do. 7 per cent. Pref.	7	7½	—	4 10 4
Charing Cross Ordinary	5	4½	—	5 11 1
do. do. do. 4½ Pref.	4½	4⅛	—	5 9 1
do. do. City Pref.	4½	4	—	5 12 6
do. 4 Deb.	4	90	—	4 9 0
Chelsea	5	4⅝	—	5 8 1
do. 4½ Deb.	4½	92	—	4 17 10
City of London	9	14⅜	—	6 5 2
do. do. 6 per cent. Pref.	6	12½	—	4 18 0
do. do. 5 Deb.	5	113	—	4 9 3
do. do. 4½ Deb.	4½	98	—	4 11 10
County of London	7	11½	+ ⅛	6 1 9
do. do. 6 per cent. Pref.	6	11⅜	—	5 8 6
do. do. 1st Deb.	4½	100	—	4 10 0
do. do. 2nd Deb.	4½	95 xd	—	4 14 9
Kensington Ordinary	9	7	—	6 8 7
London Electric	4	1⅜	—	6 18 0
do. do. 6 per cent. Pref.	6	5	—	6 0 0
do. do. 4 Deb.	4	87	—	4 12 0
Metropolitan	8½	8½	—	5 12 5
do. 4½ per cent. Pref.	4½	4	—	5 12 6
do. 4½ Deb.	4½	94	—	4 15 9
do. 3½ Deb.	3½	75	—	4 13 4
St. James' and Pall Mall	10	8	—	6 5 0
do. do. do. 7 per cent. Pref.	7	6⅞	—	5 9 10
do. do. do. 3½ Deb.	3½	80	—	4 7 6
South London	5	3	—	6 18 4
South Metropolitan Pref.	7	1¼	—	6 4 5
Westminster Ordinary	9	7½	—	6 0 0
do. 4½ Pref.	4½	4½	—	4 12 4
TELEGRAPHS AND TELEPHONES.				
Anglo-Am. Tel. Pref.	6	106½ xd	+1½	5 12 8
do. Def.	1½	22⅝	— ⅛	6 11 10
Chile Telephone	8	6⅞	+ ⅛	5 16 5
Cuba Sub. Ord.	5½	8⅝	—	6 5 9
do. Pref.	10	16	+ ⅛	6 5 0
Eastern Extension	7	13½	—	5 5 8
do. 4 Deb.	4	92	—	4 7 0
Eastern Tel. Ord.	7	136	—	5 3 0
do. 3½ Pref.	3½	74	—	4 14 7
do. 4 Deb.	4	93	—	4 7 0
Globe Tel. and T. Ord.	6	11¼	—	5 6 8
do. Pref.	6	12	— ⅛	5 0 0
Gt. Northern Tel.	22	32	+2	6 17 6
Indo-European	65/-	56	+1	5 16 1
Marconi	20	1¾	—	11 8 6
New York Tel. 4½	4½	98 xd	—	4 11 6
Oriental Telephone Ord.	10	2 7/16	+ 1/16	4 17 0
do. Pref.	6	1 5/8	—	5 1 1
Tel. Egypt Deb.	4½	88	— ½	5 2 3
United R. Plate Tel.	8	6½	+ ¼	6 3 1
do. Pref.	5	5	—	5 0 0
West India and Pan.	1	1 5/16	—	3 16 2
Western Telegraph	7	13⅜	—	5 2 8
do. 4 Deb.	4	92½	— ½	4 6 6
HOME RAILS.				
Central London, Ord. Assented	4	78	+ ½	5 3 2
Metropolitan	1½	29½	—1	4 4 9
do. District	Nil	17	— ½	Nil
Underground Electric Ordinary	Nil	1⅛	—	Nil
do. do. "A"	Nil	5/6	-3d.	Nil
do. do. Income	6	81	—	7 8 3
FOREIGN TRAMS, &c.				
Anglo-Arg. Trams, First Pref.	5½	4 7/16	+ ⅛	6 4 0
do. 2nd Pref.	6½	8¼	—	7 2 0
do. 4 Deb.	4	83	—	4 16 5
do. 4½ Deb.	4½	89	—1	5 0 0
do. 5 Deb.	5	89½	—	5 11 9
Brazil Tractions	6	55¼ xd	—1	10 16 2
Bombay Electric Pref.	6	10⅜	—	5 16 10
do. 4½ Deb.	4½	91	—	4 19 0
Mexico Trams	Nil	30	—	Nil
do. 5 per cent. Bonds	—	58	—	Nil
do. 6 per cent. Bonds	—	85	—	Nil
Mexican Light Common	Nil	20	—	Nil
do. Pref.	Nil	42	—	Nil
do. 1st Bonds	—	50	—	—
Adelaide Sup. 6 per cent. Pref.	6	6½	—	5 14 3
do. 5 Deb.	5	103	—	4 17 1
MANUFACTURING COMPANIES.				
Babcock & Wilcox	14	52/-	—	5 7 8
British Aluminium Ord.	5	20/6	—	4 17 7
do. Pref.	6	18/6	—	6 9 9
British Insulated Ord.	15	11½	—	6 10 5
do. Pref.	6	6⅜	—	5 0 0
British Westinghouse Pref.	7½	1 15/16	—	7 15 0
do. 4 Deb.	4	72	—	5 11 1
do. 6 p. lien	6	99	—	6 1 8
Callenders	15	12	—	8 6 8
do. 5 Pref.	5	5	+ ⅛	5 0 0
do. 4½ Deb.	4½	98	—	4 12 4
Castner-Kellner	15	3 5/8	—	4 10 6
Edison & Swan, £8 pd.	Nil	13/3	+3d.	Nil
do. do. fully paid	Nil	1½	—	Nil
do. do. 4 Deb.	4	63	—	6 7 0
do. do. 5 % Deb.	5	60	—	8 6 8
Electric Construction	5	13/6	—	7 5 6
do. do. Pref.	7	1	—	7 0 6
Gen. Elec. Pref.	6	10½	—	5 18 5
Henleys	20	14½	—	6 18 0
do. 4½ Pref.	4½	4⅝	—	4 12 4
do. 4½ Deb.	4½	97	—	4 12 9
India-Rubber	5	9⅛	—	5 9 7
Telegraph Con.	20	37½	+ ¼	5 8 6

METAL MARKET.

Fluctuations in April.



A New Radioscopic Process for Localising Bullets.—A very simple method of finding the depth of a foreign body in the flesh is described in the *Genie Civil*, as the invention of Messrs. Hirtz & Gallot. The patient is laid on a table, with the X-ray tube beneath it, and a fluorescent screen with a hole at its centre is supported above him. The tube and screen are moved so that the vertical ray from the tube throws the shadow of the bullet or splinter on the hole in the screen, and a mark is made on the skin of the patient at that spot. The tube is then moved in any direction in a horizontal plane, and the new position of the shadow is marked on the screen. The patient is then removed, and the screen replaced in the same position as before. The tube, still in its last position, is operated, and a plumb bob is lowered through the hole in the screen, until its shadow falls upon the spot marked on the screen; the bob is then in the exact position previously occupied by the bullet, and the depth of the latter is thus at once obtained.

East Africa Protectorate.—The annual report for 1913, by Mr. F. W. Major, Chief of Customs, East Africa Protectorate, shows that the value of imports of electrical apparatus advanced by £3,481 to £6,970. Industrial machinery imports were up by £15,199 at £66,771. All classes of metals, manufactured and unmanufactured, porcelain, china and earthenware, iron and steel ware, and hardware, also scientific instruments showed satisfactory advances. The enormous expansion in industrial machinery is more apparent when it is mentioned that the figure of £66,771, compares with only £21,065 two years earlier. Machinery imports of all kinds take the fifth place in order of value. Telegraph materials almost entirely British imported for the past three years have been £16,795, £19,839 and £10,048 for 1912-13-14 respectively.

POWER PLANT TESTING.

At a meeting of the Scottish Local Section of the Institution of Electrical Engineers on April 13th, a discussion took place on Mr. Selvey's paper on power plant testing, which was abstracted in our issues of December 11th and 18th, 1914.

Mr. W. W. Lackie (Glasgow), while agreeing that in cities, towns, and areas having a population of over 500,000 there would be a complete obsolescence, in from eight to ten years, of plant purchased at the present time—rated at less than 5,000 kw. in the case of turbo-alternators or 30,000 lb. for boilers—he did not think that this was a correct statement as applied to smaller towns. He agreed that they might look forward to a load factor of approximately 50 per cent. on their works, and that economy in fuel ought to be one of the first considerations in buying new plant; but in his figures to show the importance of low steam consumption, he thought Mr. Selvey rather over-stated the case. Mr. Selvey had entirely omitted to take into consideration the extra interest, depreciation, and sinking fund on the additional £24,000, and that at 8 per cent. represented £1,900, or over £15,000 in eight years. The net result was that the machine taking 1 lb. less per kw.-hour on 8,000 hours' load was worth only £8,600 more, and on 4,000 hours' load it would be worth only £4,300 more. He did not wish to depreciate the importance of steam consumption, indeed Mr. Selvey could have gone further. If a set of turbines was bought to take 5 per cent. less steam it followed that 5 per cent. less boiler plant would suffice also. As to the testing of plant, within recent years they had had to test 3,000, 4,000, and 6,000-kw. turbines and boilers of 30,000 lb. evaporation. One series of tests represented ten sets of readings, and it took 110 sheets of foolscap to make a proper record of these tests, necessitating a staff of 20 to 24 men, but the importance of having the facts accurately set down was seen when one remembered that every tenth of a pound of steam over 13.7 lb. meant a penalty of £750 to the contractors. He did not think that any manufacturer would agree to let the plant run for six months before a test was made, unless he got payment for the plant on erection, and, alternatively, no buyer would agree to pay for the plant until it was officially tested. The plant should be tested as soon as possible after erection, and again twelve months thereafter; but before the second test the contractor should have an opportunity of examining the turbine, and there should be no decrease in the efficiency of the turbine at the end of that period.

Mr. Page (Glasgow) pointed out that the difficulties between buyer and seller arose when the tests proved non-compliance with the specification, more especially if the tests were carried through by engineers in the buyer's employment. This showed the desirability of having specialists who would be accepted by both parties to carry out tests. The trouble all along had been that there were so many variables. On getting in tenders, the steam consumptions were invariably given with a margin of 2½ per cent. They had succeeded sometimes in getting the successful contractor to depart from this stipulation, but the I.E.E. Model General Conditions embodied an allowance to cover errors in observation. The remarks on obsolescence hardly applied to boilers in the same sense as to turbines. The smaller size of water-tube boiler with, say, 4,000 sq. ft. heating surface, installed 20 years ago, was just as efficient to-day as boilers put down recently. The same certainly could not be claimed for turbo-alternators. He could confirm what was done in power stations with new turbines in running them almost continuously. Fifteen months ago the Glasgow Electricity Department installed a 6,000-kw. set. It was hardly fair to take the figures for the first six months, because during that time the turbine had to be tuned up, but if they took the second six months of the first year of that plant's life, he found they ran this 6,000-kw. set for 55 per cent. of the total load, and that it was responsible for 22½ million units out of a total output of 33½ million units, which only left 11 million units to be taken from the other plant. The capacity of the plant was 22,000 kw., leaving 16,000 kw. after the 6,000 kw. set was accounted for. Over the year the 6,000 kw. machine generated 40,000,000 out of the total of 61,000,000 units, although the total plant capacity was fully 22,000 kw., and that fully bore out Mr. Selvey's contention that one-tenth of a pound of steam saved was extremely valuable. Automatic CO_2 apparatus required to be used with discretion, the firemen being so apt to cut down air supply and thus lower the output of the boiler in their efforts to get high CO_2. Indicating steam meters on each boiler helped greatly not only to work in conjunction with the CO_2 apparatus, but in the event of a shortage of steam to tell the engineer in charge where the trouble lay. In Glasgow they made a standard practice of having such a meter on every boiler. It served the same purpose as an ammeter on a generator, and had been found to be a thoroughly sound investment. Draught gauges connected above the fire and between the top of the fire and the back end of the boiler served not only their legitimate functions, but also showed at once when the boiler required cleaning. They had found this to be an even more certain way than going by the readings on thermometers, as excess air tended to lead them astray when depending upon the thermometers at the boiler and economiser

dampers. As to fuel analyses, they found they could now buy coal on the daily figures obtained in the Electricity Department Laboratory. Mr. Selvey spoke of the higher calorific value of coal, but manufacturers were not much inclined to depart from the older method which employed a lower calorific value. Some pronouncement was wanted on the exact number of B.TH.U. in a KW.-hour. Marks and Davis put it at 3,415. Some of the engineering year-books gave it as high as 3,420, and manufacturers varied from 3,411 to 3,415. When considering tenders the difference in these figures had its effect in getting at a fair comparison. They had found that the rotary air pump performed its work very well, but some forms took too long to create the vacuum in the condenser at starting. Where steam or water ejectors were employed this trouble was greatly reduced. The figure of 1.3 lb. of air per 1,000 lb. of steam was much too high. An air pump capable of handling that quantity of air and yet only being called upon to deal with about 0.4 lb. per 1,000 lb. was wasting power continually. The better arrangement was to put in two sets of air pumps, each capable of dealing with 0.5 lb. per 1,000 lb. and run only one under normal conditions, the other being brought into service when there was excessive air leakage or when there was something wrong with the first one. The temperature of the sealing water to these rotary air pumps should be kept down, as this had a bearing on the power taken to drive them. On the question of the size of surface condensers, to allow one square foot of surface for every 5 lb. of steam seemed to him on the high side. Even with high inlet cooling water temperature, where K had to be run up, 1 sq. ft. to 6 lb. should be enough, and on jobs where the inlet cooling water temperature might be as low as 50° F., 7½ lb. ought to be condensed per sq. ft. The coefficient of heat transmission referred to as K would repay study. It ought never to be referred to unless the whole application of this factor was thoroughly understood. For instance, it might be as low as 300 and as high as 1,000 B.TH.U., and it depended upon local conditions; and the correct K for one job was probably quite wrong for the next. The tendency, however, when the cooling surface was not specified, was to keep that down, working with high K brought about by high velocity of the cooling water through the tubes. In plant running on a good load factor this might mean very high pumping costs, and as a rule it generally paid to buy more surface and keep down the friction head against the pumps.

Mr. D. A. STARR (Glasgow) thought that high efficiency was sometimes obtained at the expense of good mechanical construction, and good efficiency could be obtained sometimes with more rugged construction and better clearance between running parts, etc. No matter how carefully the testing was carried out, the main thing was the economical operation of the plant afterwards, and he thought it was important to watch results very carefully from the coal to the output of the station. In many undertakings the class of fuel varied, not only in calorific value but in size and quality also, and if careful analysis was made and the size of coal kept account of week after week, in conjunction with the load factor of the station; the output and the relative demand on the sizes of units in commission, as well as the lb. of coal per unit sent out, and the cost per ton of each class would indicate in the cost per unit whether the plant was keeping within its test conditions.

Mr. J. K. STOTHERT (Glasgow) emphasised the need for experienced and expert observers. Unless the methods for making the various measurements required in boiler trials were standardised and of calculating efficiencies were on the same basis, the results, apart from the accuracy of observations, were bound to be different and possibly misleading. He thought that the report of the Committee of the Institution of Civil Engineers on tabulating the results of steam engine and boiler trials recently published, if adhered to by engineers, would tend to attain the object which the author had in view. The author attached too much importance to the value of the CO_2 measurements, which might be used to cause a waste of money instead of the saving counted on. As a matter of practice, the cost of evaporating 1,000 gallons was the best test, and the CO_2 records were a guide to help them to attain the result. There was a good deal to be said for the author's desire for specially designed furnaces for each class of fuel, but he was afraid that this was ideal. Manufacturers had to aim at an average plant, and he had often known cases of specially designed furnaces for a particular class of fuel which had proved a disadvantage to steam raising when the particular kind of coal was unavailable.

In the course of his reply, Mr. SELVEY said that he found it took six months to tune up a plant, and, personally, he would not advise testing until that period had elapsed. A matter of 3 per cent. reduction in efficiency was not likely to occur on large sets, but it certainly occurred a great deal upon some of the smaller power station sets, and it arose very often through running with too fine clearances. There were many pitfalls in testing, and people seldom got within 2 to 4 per cent. He had not been pleading for a very high CO_2, but he thought 6 per cent. was upon the low side and ought to be improved. A very high CO_2 in the absence of complete knowledge had often led to extraordinary results. The question about K was rather a subtle one, and there was no doubt generally that they were returning to a reasonable water velocity and consequently a more reasonable pump power. A furnace was usually specially designed for a poor class of coal, and there was no difficulty in running in a better class of fuel. He was recently testing a new gas engine, of which the makers wanted to know the lower calorific value. He spent six weeks in trying to find that out, and he had great pleasure in telling them that there was no such thing. He consulted twenty-two authorities and text-books, and the ultimate conclusion he came to was that there was complete disagreement, while as to the value of the B.TH.U. per KW.-hour he would say it was 3,413.7.

THE POWER SUPPLY OF THE CENTRAL MINING-RAND MINES GROUP.

By J. H. RIDER, M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS, *April 15th*, 1915.)

(*Continued from page* 636.)

In 1913 a new type of control apparatus was suggested by the South African General Electrical Company (G.E. Co., of America). The general arrangement of this apparatus is as follows:—

(1) Electrically-operated contactor switches are used for the stator circuits, similar to those now working on several 3-phase winders on mines of the group.

(2) The rotor resistance is of the metallic type, the various sections being cut in and out by a series of nine 3-pole electrically-operated contactor switches.

(3) The operation of the stator and rotor contactor switches is effected by a small master controller of the cylindrical type mounted on the driver's platform. The controller lever moves in a similar manner to the ordinary operating lever.

(4) The rate of accelerating the speed of the motor is automatically controlled by a relay system in the rotor circuit, so that, although the control lever may be put right over at the start, no succeeding rotor switch closes until the rotor current, which has increased on the closing of the preceding rotor switch, has fallen to a predetermined and adjustable amount.

The advantages claimed for this method of control were:—

(*a*) No heavy work is imposed on the driver in operating the control lever.

(*b*) No energy is wasted in continually pumping electrolyte.

(*c*) The full speed of the motor is obtained, as, when the last rotor switch closes, the rotor is metallically short-circuited.

(*d*) No energy is wasted in the rotor resistance during the period of full-speed running, but only during the periods of acceleration and retardation.

(*e*) There is no possible risk of flashing over, however quickly the control lever is operated.

(*f*) There is no cooling pipe system to be kept clean and in order.

The equipment was erected in the winding engine-room at the Village Main Reef, Ltd., and was used with great success for several weeks, during which time the drivers expressed themselves as being very well satisfied with it. Several defects in the apparatus appeared, however, as follows:—

(1) The control gear was mounted on a pipe framework on the light wooden floor of the engine-room. The continual opening and closing of the contactors shook the bolts loose, and it was soon seen that the mounting was too light and should be on a solid floor.

(2) The rotor resistance was formed of metallic grids, built up in frames like an ordinary tramcar resistance. These frames were arranged in a metal tank filled with water to keep down the temperature. The water and the electrolytic action gradually destroyed the insulation between the grid sections, and affected the cable contacts on the grids.

Apart from these defects the general working was so satisfactory that it was decided to re-erect the control gear on a solid framework and foundations in a small house outside the engine-room, and to use, instead of cast-iron grids under water, a series of air-cooled rods or tubes for the main portion of the rotor resistance and three iron plates in water for the remainder. Several experiments were made to ascertain the correct size and lengths of the rods, and the whole arrangement as completed now appears to be quite sound and effective. The gear is illustrated in figs. 2 and 3.

Fig. 2 shows the stator contactor switches and fig. 3 the rotor contactor switches. It is in successful daily operation at the Village Main Reef G. M. Company, Ltd. Although a little more expensive in prime cost than the ordinary type of liquid control, this is more than repaid by the effectiveness and the saving of the heavy losses in the rotor resistance during the times of full-speed running.

With a view to obtaining competitive arrangements, the author, in July, 1914, sent particulars of the contactor-relay system of control to a British firm which claims to be expert in that class of work. It took nearly five months for a reply, other than an acknowledgment, to be received, and then the information sent was entirely useless. Wake up, England!

Electrically-operated contactor switches for the stator circuits are used with great success on several 3-phase winders of the group. The contacts are self-cleaning and are broken under a magnetic blow-out, and the maintenance is exceedingly small when compared with the ordinary pattern of oil switch. A contactor switch is shown in fig. 4, from which its essential parts will be seen.

Manufacturers do not seem to realise the nature of the duties which winder oil-break switches have to perform, and they usually supply the ordinary switchboard type. While the latter is only called upon to open and close feeder or machine

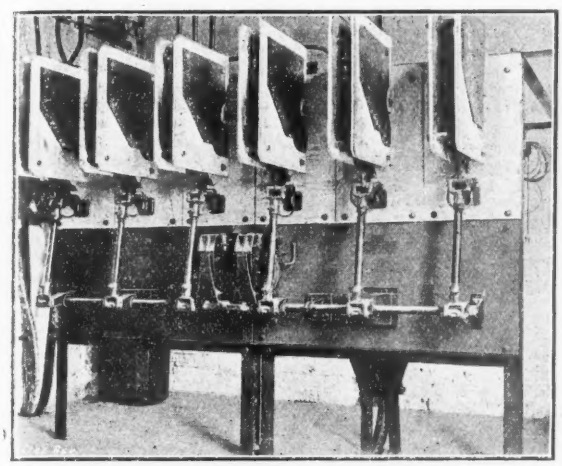


FIG. 2.—STATOR CONTACTOR SWITCHES.

circuits occasionally, and generally with no load on at the time, switches for 3-phase winders frequently have to make and break circuits from 500 to 1,000 times per day, and the breaking is usually done under full load. It requires a very substantial switch to stand up to this sort of work, and the arcing contacts and the oil have to be renewed at least once a week. This is a very "messy" and expensive job, and contactor switches are being insisted upon for all future 3-phase winders. On a 3-phase winder at Rose Deep, Ltd., these switches have made and broken the stator circuits over 388,000 times without any cost whatsoever for repairs or maintenance.

The deeper the shaft the cheaper is the 3-phase system compared with the Ward Leonard, particularly if the contactor system of rotor control is used, because with the latter the resistance losses are entirely eliminated at full speed. With balanced (double-drum) winders working without a tail rope, there is, however, a limit to the depth at which a 3-phase

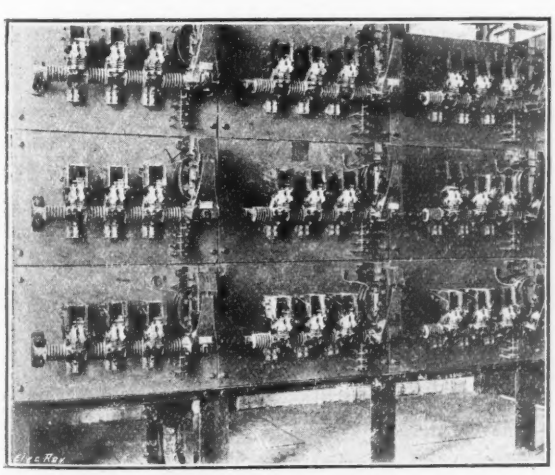


FIG. 3.—ROTOR CONTACTOR SWITCHES.

winder is the more economical, because the weight of the descending rope ultimately overbalances the weight of the ascending load and reverse current has to be applied to prevent the winder running away. Such energy has to be paid for, but with the Ward Leonard winder the greater part of the breaking energy can be returned to the line. There is therefore not only the saving of a loss, but a distinct gain to be made.

For a winder which is frequently or constantly used for lowering loads, such as men or material, or, in some cases of inclined shafts, lowering rock to a point where it can be better raised by a vertical shaft winder, the Ward Leonard system is much to be preferred.

It is only by drawing out a diagram for each individual case that a proper decision can be made as to which type of winder is the correct one to employ.

One advantage which the 3-phase winder has over the Ward Leonard is that geared motors running at 375 R.P.M., or at higher speeds, can be most conveniently employed in the majority of cases, which not only means a much cheaper equipment, but a better and more economical motor than if a

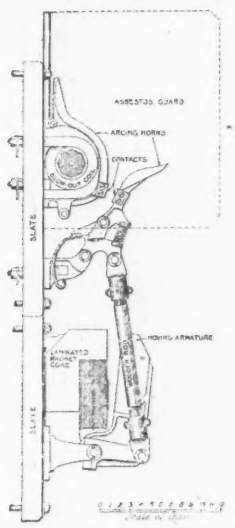


FIG. 4.—ELECTRICALLY-OPERATED CONTACTOR SWITCH.

direct-coupled one were used. With the Ward Leonard system a direct-coupled low-speed motor, although more expensive, gives a better working machine.

Most of the so-called overwinding accidents which have occurred on the Rand have been caused, not by any failure to stop the skip, but by starting the winder in the wrong direction when one skip is at the tipping point. In such cases the skip is pulled into the headgear sheaves before the winder drum has made half a turn.

Overwinding devices which cut off the supply of energy when the skip has reached a pre-determined point are not of much use for avoiding such accidents, because the driver must retain full command of the winder, in whatever position the skip is, to be able to bring the skip to the exact tipping point. This operation frequently calls for slight movements of the winder after it has first been stopped.

In 1912 the author's attention was directed to an electrical

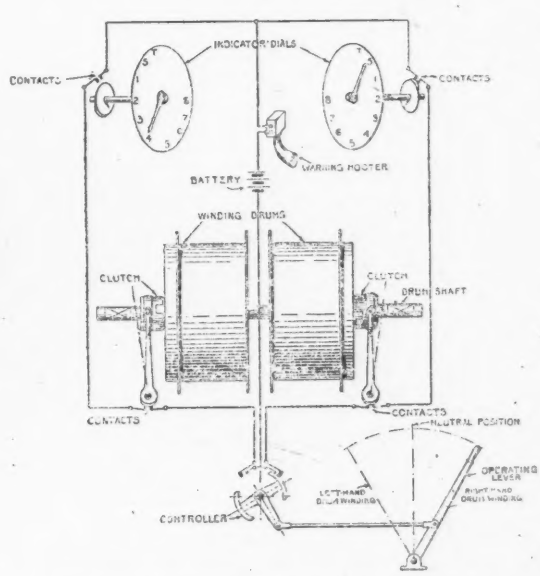


FIG. 5.—DIAGRAM OF PHILIP'S INDICATING DEVICE.

device in use on certain winding engines at the Simmer and Jack East mine, near Johannesburg, the invention of Mr. W. Philip, the resident engineer, which, it was claimed, would give unmistakable warning to the driver if he attempted to start the winder in the wrong direction with the skip in the tip, without in any way taking away from him the full command of the winder. On investigation this claim was found to be fully justified, and since that date the whole of the

winders on the mines of the group have been fitted with the Philip device. The action is as follows:—

A 2-way controller switch is connected to the driver's operating lever, so that the contacts are open when the lever is in the neutral or "off" position. A slight motion of the lever in either direction closes the contacts on one side or the other. An insulated disk, with a short metallic insertion on the edge, is fixed on the spindle of each depth indicator dial, with two contacts arranged so that the circuit is closed when the depth indicator shows the skip to be anywhere in the region between the headgear sheaves and, say, 150 ft. below the collar of the shaft.

A battery and a loud warning hooter complete the apparatus, which is connected up as shown in fig. 5. In the case of winders with loose drums operated through clutches (a great many of these winders are in use on the Rand to wind from different levels) an auxiliary contact is provided which is broken when the clutch is open and the brakes are holding that drum.

By following through the connections it will be seen that when a skip is within what may be called the "danger zone" the smallest movement of the operating lever in the direction to raise the skip will sound the hooter, which is placed close to the driver. He is at once warned, and unless he has deliberately put his lever into that position he quickly pulls it back before any damage has been done. He can only raise the skip within the danger zone with the full knowledge of what he is doing, and he is also warned by the hooter if he keeps the power on past the pre-determined point in the shaft. This simple apparatus has already been the means of preventing a great many accidents.

(To be continued.)

Discussion at Manchester.

Mr. S. J. Watson said it was difficult to understand why the power plant load factor should be about 75 per cent. whilst the load factor of the air system was only 30 per cent. The 75 per cent. load factor indicated that some of the processes were working right through the 24 hours, and presumably the processes employing air compressors were only used part time.

Mr. A. E. MacKenzie said the author had uttered a word of warning, which some engineers present would perhaps have to take to heart during the next few years, in stating that it was only courting failure to attempt to give a permanent and reliable supply without a proper reserve of generating and transforming plant. Many central station engineers in this country would be pleased indeed to have the reserve of 25 per cent. which the author considered essential for a large supply like the Rand. It was difficult to understand why the power company stipulated in their agreement a possible frequency variation of 10 per cent.; such a variation would not be good enough for a Lancashire cotton mill owner, and considering a 75 per cent. load factor and the serious trouble encountered by the author with stamps and speed of rotary mills, it would appear that this variation was frequently obtained. The expense of three meters was warranted in view of the immense power to be metered. It would appear advantageous to have each series of three composed of different types, preferably with different characteristics. The author stated, "It is a very common and erroneous practice to install oil switches without considering the volts that they may be called upon to deal with." In justice to engineers in this country, the author should substitute "was" instead of "is," as this feature had been generally recognised in this country for a long time. Regarding a switchboard maker's guarantee as to the maximum kw. which could be safely broken at normal voltage, the speaker would not place the slightest reliance upon such a guarantee.

Mr. Alcock was much impressed by the permissible pressure variation of 10 per cent. up or down, especially having regard to the necessity of uniform speeds in certain operations. It would be interesting to consider how far this power supply would have been commercially feasible if in the first place the power company had been compelled to deliver energy under the rather restricted variations prescribed by the Board of Trade.

Mr. W. H. Lea, who returned from the Rand about nine years ago, expressed his surprise at the phenomenal change in plant which had taken place since he left. The weights of the stamps ten years ago varied from 750 to 1,250 lb., whereas to-day they were 2,000 lb. Again, the heaviest skip load encountered by the speaker was four tons, against the modern eight tons. The suggestion had been made some years ago to employ taper ropes having a top diameter of about 2 in. and bottom diameter about ¾ in.; had this been developed? The idea of placing the crushers at right angles to each other was quite novel and good.

Mr. Cramp asked why, both in the present paper and that read by Mr. Sparks, nearly the whole of the mining machinery appeared to have been obtained anywhere but in this country. If the motors, centrifugal pumps, and compressors were better designed and better made abroad, the sooner this was realised the better: if such was not the case, what was the reason for so little of the machinery being made here? It was clear that recently some of the switches had not been made abroad, and it was only fair to the English that the point should be emphasised. If it were simply a question of price, that was another matter. Regarding the control of winding machinery, the cascade motor had not been mentioned, but nevertheless was worthy of consideration. Instead of wasting the energy absorbed in the rotor resistance, the intermediate system might be adopted, whereby the rotor currents were led to a small polyphase motor which would make use of the energy so provided to drive additional machinery. This system had been successfully adopted in mining in this country. In any case it was more efficient than the plain polyphase system, and actually was about a mean in cost and efficiency between the plain polyphase system and the Ward Leonard control. The author's use of the term "root mean square" was not clear.

The Author, in reply, said that under the agreement with the power company the Rand Mines group took the whole of their power from the company. Steam plant was entirely scrapped. The price paid was 0.525d. per unit, but with certain discounts dependent upon the carriage on coal, etc., the net price came down in round figures to 0.5d. The air unit was paid for at the same figure. Regarding the large difference between the load factors for electricity supply and air supply, the reduction operations on the mines continued uninterruptedly except for a few hours a month to clean up. The only variable electrical load was the winding, the pump load and everything else was constant. If the winders were removed, the load factor would increase from 75 per cent. to 98 per cent. The air load factor, on the other hand, was low on account of the drilling, which could not be a continuous operation. The drilling was done on a single shift, and generally finished about one or two o'clock in the day. The hole was then charged and blasted. Some mines had two drilling shifts, one day and one night shift, which improved the load factor, but it could never be as good as the electrical load factor because of the time occupied in charging, blasting, and clearing away the rock. The gate meter was certainly better than the Venturi, and anyone interested in air meters should consult Mr. Hodgson, who was an expert on such matters. Contrary to Mr. Alcock's assertion, pressure variations did not affect the speed, this being governed by the frequency. The transformers used by the power company were oil cooled, with a natural air draught coming in from outside. The question of taper ropes raised by Mr. Lea brought up an old story and an important point. The depth from which a winder could draw rock was dependent upon the rope, and if carried to extreme depth the rope alone would represent the full load without any addition. This point led to the suggestion and trial of the taper ropes referred to by Mr. Lea, but they were quickly given up. The author had no actual report of the reason of failure, but suggested that difficulties were experienced in working such ropes on the drums. The existing ropes were 2 in. in diameter, and the greatest depth of any winder was 4,144 ft. There was another reason besides that of the rope which determined whether one or two winders should be used, one winder being at a lower stage. A deep shaft of, say, 5,000 ft., using only one winder would produce 5 to 8 tons at one operation, and with the winder going at 2,500 ft. per minute would take 2 minutes to get the rock to the top. If another winder were installed half way down, so as to wind in two stages, twice the amount of rock could be dealt with in the same time. This was the critical point determining whether to use one winder or two. Regarding remaining steam plant, as stated previously, the whole of the Rand group was electrified, but there were other mines on the Rand which had not contracted for the whole of their supply and retained steam, particularly for winders, because unless they contracted for the whole supply they could not get a flat rate. They chose that type of load on their mines which gave the best load factor, and thereby brought their rate down. In reply to Mr. Cramp, more than half the plant was ordered out of England, a good deal being bought from America. The author had pointed out to the owners that there were points other than price to be considered in placing orders, but, nevertheless, three-quarters of the plant was ordered almost entirely on a price basis. Lately, however, matters were altered and the price question had been largely eliminated in favour of quality. Reliability was the first demand, and efficiency to the purchaser meant something which would always run and give no trouble with ordinary attention. Balanced three-phase meters were used throughout, as the loads, except in the case of a few odd circuits, were balanced. There were no three-phase cascade motors on the Rand group, and the author did not feel disposed to go out of his way to adopt them. If a plain three-phase winder was unsuitable, the Ward Leonard type would be installed. The formula for the air meter had been proved correct by the measurements of the displacement meter. The size of the orifice should be about ¾ in., which could be made within reasonable limits, say, ½ in. up or down. It could be used without objection if it came within those limits. There was no apparent reason why rope-driving should not be used other than the enormous amount of space occupied by the rope drive. It was much cheaper and better in every respect to install high-speed compressors. The author had no figures regarding air losses in pipes, but emphasised the importance of maintaining a good air pressure at the drills. The definition "root mean square" was not, perhaps, a scientific expression, but its meaning was obvious: it was the true average horse-power which the plant was called upon to do. The term was in common use on the Rand, and if it were stated that a winder had a root-mean-square power of 2,000, it meant that in starting the machine might have to develop 4,000 h.p. for a short time.

THE RHEOSTATIC CONTROL OF SEPARATELY EXCITED GENERATORS.*

By L. BOOTHMAN.

The use of a main field rheostat in conjunction with an exciter field rheostat is in some cases necessary, particularly where the voltage of the exciter circuit must be kept perfectly constant—for instance, where the exciter is also being used for lighting purposes; but in most cases the main field rheostat can be dispensed with entirely and the whole regulation obtained by the exciter field rheostat alone. The resultant saving in first cost, the saving of a continual larger watt loss due to a main field rheostat, and the saving in space, together with the increased simplicity of a single rheostat, make the use of such a method of control worthy of consideration. Such rheostats, however, must have a large number of steps of resistance in order to compensate for the following variable factors:—

The forms of two curves are required to be known for stepping out the rheostat resistance, namely, the load saturation curve of the generator and that of the exciter. These curves are usually calculated or are taken from tests of similar machines, and in either case some variation is to be expected, due to natural differences in material and differences in reluctance of the joints in the magnetic circuit.

Again, there is approximately twenty per cent. resistance variation in both machine fields from the cold to the final temperature when running, thereby displacing by a proportionate amount, during this period, the working position of the exciter field rheostat.

A further variation may be produced if an alteration in speed occurs, especially at low loads, if the exciter saturation curve approximates a straight line form at this position. This, of course, raises or lowers the terminal voltage of the generator in sympathy with the alteration in speed.

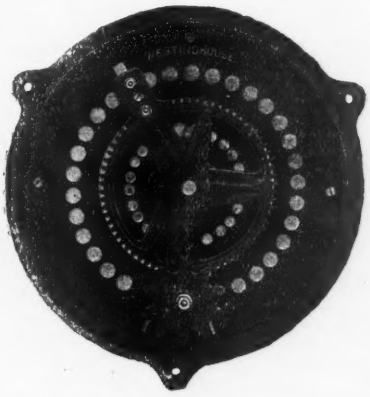


Fig. 1.—Type "MBR" Field Rheostat giving 280 to 308 Steps.

Displacement of the commutating brushes of the exciter from the correct or neutral position, particularly if the machine has interpoles, affects the shape of its load saturation curve with a consequent derangement of the stepping of the rheostat resistances.

Where an alternator is designed for a certain power-factor and is run on a load with a different power-factor, the necessary range of exciter voltage is changed. For example, when running on a load with a lower power-factor, a larger amount of resistance is required in the working range of the exciter rheostat.

The rheostat must have a sufficient number of steps to ensure that the permissible variation of generator voltage on load is not exceeded, also, the total ohmic resistance must be sufficient to obtain the lowest generator voltage required at no-load.

The conclusion derived from the above considerations is that an evenly divided resistance in the exciter rheostat is the best proposition in order to cover all the above points.

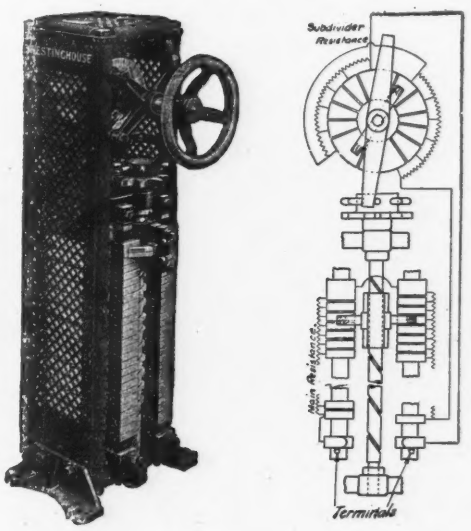
The usual exciter field rheostats now on the market, with about one hundred to one hundred and twenty-five steps maximum, have not a sufficient number of steps to render this proposition possible. If it were attempted to carry it out on them the regulation on the working range would be too "coarse," *i.e.*, there would be too much resistance between each step. In these rheostats, therefore, relatively large steps of resistance are inserted from the "all out" position up to where the estimated working range is reached, and comparatively small steps of resistance are inserted over the working range, with a few large steps at the no-load end to allow of some margin.

What is needed therefore is a rheostat of reasonable dimensions and cost, and with a large enough number of steps to allow of the resistance being stepped out evenly over the whole range. Rheostats which fulfil these conditions have been developed and patented by the British Westinghouse Co., and are shown in figs. 1 and 2. These rheostats, by means of a novel contrivance, give a large number of steps, and at the same time occupy about the same, or less, space than the usual form of exciter field rheostat. They are made in two types, viz.: a "straight" pattern designated MB. St. type with five hundred to five hundred and fifty steps, and a smaller round pattern designated MBR type, with two hundred and eighty to three hundred and eight steps.

The operation of both types is practically the same, and will be readily understood from an explanation of the type MB. St., which is illustrated in fig. 2.

This rheostat consists essentially of two rheostats connected in series, as shown in the diagram, the whole of the resistance of one rheostat called the "subdivider" being equivalent to one step of what is termed the "main" rheostat, which in this type is the straight portion.

By revolving the operating hand-wheel half a revolution in one direction, the ten steps of the subdivider resistance are cut out, and a slight further movement in the same direction puts the whole subdivider again in circuit. Simultaneously with the latter movement the equivalent resistance of one step is cut out of the main rheostat resistance. This is accomplished by means of the double arm, shown in fig. 3, which engages with and revolves the capstan fixed to the quick traverse screw which moves the brush of the main rheostat.



Figs. 2 & 3.—Illustration and Diagram of Type "MB. St." Field Rheostat giving 500 to 550 Steps.

It will be seen, therefore, that each main step of resistance is sub-divided and is cut out in ten steps every time the hand-wheel is rotated half a revolution in the one direction; the action is similar when putting resistance in.

There are in this type fifty steps in the straight portion and ten in the subdivider, thus obtaining, with twenty-five revolutions of the hand-wheel, five hundred steps from the "all in" to the "all out" position.

If the total subdivider resistance is arranged to be only ten-elevenths of the resistance of one main step instead of equal to it, then the eleventh part will be cut "in" or "out" as the case may be, during the transition stage of "balancing," and thus a total of $11 \times 50 = 550$ steps will be obtained.

As before stated, the type "MBR" rheostat operates in a similar manner to the type "MB St." just described. In this case, however, the double arm, instead of moving a capstan which actuates a quick moving thread carrying a brush, actuates a toothed wheel which in turn moves, by means of a pinion and gear wheel, a contact arm fitted to an extension of the gear wheel.

The type "MB. St." rheostat is built up of metal and mica throughout and has laminated contact brushes. The resistance units are mounted directly on to the stems of the contacts, which is a valuable feature, as it avoids any intermediate loose leads between the contacts and resistances.

The latter feature also applies to the type "MBR"; in this case, however, the contacts are mounted on a slate panel.

Both of these rheostats should have a large market in their respective spheres, as they are undoubtedly devices which have been needed for a long time.

* From the *British Westinghouse Gazette*.

PUBLICITY—THE SOUL OF BUSINESS.

By E. P. BENNETT.

"Thousands of pounds wasted daily!" A statement of considerable force, nevertheless it is one that may be equally well applied, and with as much truth, to catalogues and advertising matter generally, as to the waste-paper disposed of each day by the destructor.

The present age is one of catalogues, for to-day every firm, large or small, issues lists, from the bulky volume of the manufacturer to the schedule of prices of the retail man. These catalogues are scattered broadcast in vast quantities every year by post, rail, or contract carrier. Some are issued upon elaborate systems, cleverly thought out in every detail, and seldom fail to reach the right quarter, inevitably repaying the enterprising concern or individual in whose interests they have been compiled, while others—and these the great majority—are foredoomed to failure.

For the purpose of classification, it would be interesting to separate the firms issuing these lists into three classes, viz.:—

(1) The concern which scientifically compiles, produces, and distributes.

(2) The concern which scientifically compiles and produces, but fails in the distribution.

(3) The concern which merely commits so much matter to paper, and leaves chance to be responsible for the distribution.

The results are probably in the same ratio to the cost of production.

Consider these three sections in detail, taking for the first a manufacturing company with a number of wholesale district branches.

At the headquarters of the company there is most probably a department—not necessarily large—exclusively devoted to publicity work. This department would be in close touch with the works manager, and working in concord with the organising secretary, the former regulating the prime costs and output of material, the latter stipulating the profits to be derived. The works manager would also be responsible for the quality of the material being up to the standard of competitive makers, the organising secretary being responsible for the ultimate prices being fixed strictly in line with the market's ruling figures.

In this way, all likely demands on the factory could be promptly met and precipitate advertising avoided, and buyers would invariably find the catalogues of interest and real value, owing to the absence of enhanced or erroneous prices of general market requirements.

So far, it will be observed that the works, organising secretary, and the publicity department, have been in close touch with one another; but from now the publicity department have the matter entirely in their own hands. All details of production, arrangement of descriptive matter, illustrations, and printing, which to adequately describe would require the pen of a publicity expert, are left to them, and the whole undertaking proceeding rapidly under their supervision—a most important point in the issue of any big list, if it is to be of maximum service—the completed publication is soon ready for distribution.

Advance copies are sent to the respective heads of the departments and branch managers, immediately followed up by a small quantity being sent to each branch, and the general distribution then commences. This distribution is started immediately prior to the appearance of the trade Press notices, and should preferably be taken charge of by a supervisor in the publicity department, who has an intimate knowledge of the various clients, and proceeds in the following order:—

(1) Government departments, public bodies, and corporations.

(2) Concerns on the ledger with current accounts (and here the supervisor's duties are to eliminate the casual or chance account to which a general list could be of little service).

(3) Prospective clients.

(4) Consulting engineers, works managers, and chief draughtsmen.

The latter could use the production with advantage when making requisitions upon their own purchasing departments, and in the case of consulting engineers, the publication could be of use in connection with their specified material.

Distribution 3 and 4 would be most effectively carried out by the branches, where managers and travellers are in touch with the more important men and departments, who could not so surely be reached by post or other delivery methods.

Where a company has overseas establishments, the lists are sent in bulk to the colonial or foreign offices, and the distribution is carried out on similar lines, under the direct supervision of the local manager or agent.

The entire system is indexed on a card file, kept up to date by constant revision, particulars of which are sent in at frequent intervals from all branches and the counting-house.

When applications for lists are sent in direct, as the result of Press notices or advertisements, these are indexed in a similar way, and the branch concerned is immediately notified. These applications in connection with any big lists or publications are confirmed by the branch before despatch. Thus waste is avoided, and it is reasonably certain that the catalogues are not being sent to any undesirable individuals or firms. By this system, losses are reduced to a minimum, returns through faulty despatch are negligible, and the issue is consumed in the best directions, and, above all, no waste is encountered by quantities of the lists being hoarded and eventually destroyed, owing to their becoming out of date.

Three-quarters of the complete issue thus disposed of, the remaining portion is left for distribution against subsequent demands from the head office or the branches.

For Section 2, a similar company might be illustrated, which, though possessing a department fully capable of producing a catalogue equal in every respect to that of the firm just considered gives that department no control over the distribution, or, again, specialising only in production, lacks the initiative or interest necessary for successful distribution. In this case, the work is left largely to the efforts of the junior members of the staff, who, without the help of an adequate system, invariably fail in securing the desired results.

The issue is made before the works are in a position to supply, and the departmental heads are often left to learn from outside sources that a new list is being circulated.

Press notices are frequently overlooked, and it is certain that numerous individuals secure a copy of an expensive list which is of no possible value to them. Returns are plentiful, owing to inaccurate addressing, and in all probability the "official" distribution is considered complete with a large supply of the lists still available. Upon their gradually becoming obsolete, they are finally destroyed to make room for new publications. It would be impossible to obtain an accurate estimate of the resultant loss, for, in addition to the production expenses and the cost of the faulty distribution, there is the more important factor of orders lost which might otherwise have been secured.

Take for Section 3 concerns well known to almost everyone, because they are so numerous. Collectively, they produce vast quantities of printed matter, which can hardly be described by any other term. True, the issue may be bound in a cover of striking colour, but should a buyer secure a copy by any means, it is immediately recognised as of no value or interest, and is therefore rapidly shelved, its very colour denoting that it is the one catalogue amongst all others to be avoided.

It is in this section that the waste is most pronounced. No correct calculations of requirements are made, and to avoid shortage, excess quantities are ordered, which soon accumulate to alarming dimensions, and either for lack of accommodation, or for fear of becoming obsolete, must be sent out broadcast.

Outlets must be found, and the branches, wholesale houses, and clients, are asked to share in the work of distribution. Lists are unloaded in bulk upon these distributors, to again lie idle and untouched, for the reason that the branches are fully aware that the catalogues are unattractive or obsolete. The wholesale houses find more remunerative lines to which to give publicity, and the client, through lack of enterprise, fails to see that he might make some use of the lists to help the returns of his own retail business.

Having briefly surveyed the three sections, the matter can be summed up as follows:—If to-day "Publicity is the soul of business," then that publicity must be of a high order of intelligence, so arranged and produced that all unnecessary trouble on the part of the buyer is avoided; descriptive matter must be short and decisive, clearly illustrated, and in form easy to handle, with every facility afforded for ready reference to particular sections, and, above all, there must be constant revision to keep the whole production up-to-date.

Such matter will give the firm concerned a high standard amongst the buying fraternity and, with prompt dispatch, will reflect on the capabilities of its organisation, creating a forceful influence and compelling an ever-increasing business, turning waste into profit, and ensuring success and dividends where there is now one continued struggle for mere existence.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

AUSTRALIA.—H.M. Trade Commissioner in Australia has recently forwarded to the Board of Trade an extract from a letter which he has received from a firm in Melbourne, complaining that British firms do not always comply carefully with the regulations regarding certificates of origin for entry under the British Preferential Tariff. The extract reads as follows:—"We have recently received more than one invoice bearing on the back certificates which are inaccurately worded or signed with a rubber stamp. In such cases we have had to deposit the money and get fresh invoices from the manufacturers. It is surprising to us, as it doubtless is to you, that a large firm of British manufacturers should consider a rubber stamp signature sufficient for such a declaration as is necessary to satisfy the Commonwealth Customs. We bring these matters under your notice, thinking you may deem it worth while to mention them in your advices to the Board of Trade

with a view to manufacturers being warned as to the correct form of declaration to be used, and also as to the necessity for such declaration being properly signed and witnessed."

GOLD COAST.—The Government of the Gold Coast have recently passed an Act consolidating the Customs tariff of that Colony, to make one uniform tariff throughout the Colony in place of the former tariff applicable to parts of the Colony lying East or West respectively of the River Volta. The rates of duty leviable in that part of the Colony lying to the East of the River Volta were previously lower than those leviable on similar goods imported into that part of the Colony lying to the West of the River Volta. The rate on goods not specially mentioned in the tariff is now fixed at 10 per cent. *ad valorem* (on the value of the goods at the port from which the goods were imported); this rate would be leviable on any electrical goods not exempt from duty. The following articles are permitted to be imported free of duty: Goods imported for the service of any Public Department in the Colony; apparatus and structural materials for telegraphs, telephones and electric lighting; appliances, apparatus, and materials imported exclusively for use in any process for the separation of metals from ores; cranes, derricks, and winches, whole or in parts, and machinery necessary for working the same; scientific instruments and appliances; electrical machinery, railway and tramway plant, material, and rolling stock.

NORWAY.—The following articles are now prohibited to be exported from Norway: Copper, unwrought (except copper produced in Norway and accompanied by a certificate of origin); alloys of copper with common metals, unwrought; scrap of copper and copper alloys; wholly or partly manufactured wares of copper and alloys of copper with common metals, viz., plates and sheets, ribbons, rods, rolled or drawn wire, cup-shaped materials for the manufacture of cartridges; bolts, rivets, and nails; tubes and shaped pieces; wire twisted into ropes; cables without insulation fitted with mantle, armoured or unarmoured, also cables covered with insulating materials of all kinds; and castings.

DENMARK.—The following articles, amongst others, are now prohibited to be exported: Ferro-manganese, ferro-molybdenum, ferro-nickel, ferro-titanium, ferro-tungsten, ferro-vanadium, graphite and graphite crucibles, manganese and manganese ore.

SWITZERLAND.—Exportation of the following goods has been prohibited as from April 24th: Iron and steel sheets of all kinds, including corrugated sheets and corrugated piping; piping of wrought iron and steel with an internal diameter of less than 40 cm.

BULGARIA.—Amongst a number of other articles whose exportation from Bulgaria is now prohibited are telegraph and telephone wires, copper of all sorts, tin, lead, and other metals, also raw copper and certain forms of metal from the Plakalnitze Mine.

MOROCCO.—The Resident-General of the French Zone in Morocco has prohibited the exportation and re-exportation (in process of transit, transhipment, or under the temporary importation regime) of, amongst other articles: Electrical apparatus; rubber in any form; celluloid; iron, steel, metals and ores; machines suitable for the manufacture of munitions of war or military arms.

UTILISATION OF SOLAR ENERGY.

What was probably the most complete account yet published of work performed on the utilisation of solar energy was presented by Mr. A. S. E. Ackermann at a meeting of the Royal Society of Arts on April 28th. The author's work in Egypt with the Shuman-Boys absorber was described fully last year (see Electrical Review, April 24th, p. 722), and the present paper deals exhaustively with the methods and results of earlier workers. There is no doubt that the direct utilisation of solar energy is feasible; the only question is whether such utilisation is economically practicable. About 5,000 h.p. per acre is transmitted by the sun to the earth's surface at noon, on a clear day, and it is said that the solar energy received on 120 square miles of the Sahara is equivalent to the whole world's coal and oil consumption. Of this enormous power only about 4½ per cent. was utilised by the Shuman-Boys plant; but it must be remembered that the efficiency of storage of solar energy by plant life—from which the whole of our coalfields have been derived—is nothing like so great. Further, the thermal efficiency of the Egyptian boilers was only 40 per cent., and it is reasonable to suppose that this can be increased materially as experience is gained in sun-boiler construction. Ericsson, nearly forty years ago, claimed 72.5 per cent. thermal efficiency for his sun-boilers, and so reliable has time proved his data on the solar constant that it would be well worth while investigating the present possibilities of the boilers that he used.

Apart from bad luck in the way of purely mechanical defects in the engines and pumps installed, the Shuman plant in Egypt was affected adversely by the low steam pressure employed. Two compromises have to be made. By adopting higher steam pressure the engine efficiency is increased, but so is the loss from boiler radiation. Again, with small concentration and low boiler temperature, single or double cover glasses are required to reduce losses; but as concentration is increased, there comes a point at which the loss by reflection from a protected boiler equals the loss by radiation from a naked boiler, so that the cost and inconvenience of glass sheathing can then be avoided. Each sheet of glass involves a penetration absorption loss of about 15 per cent. On these grounds, said Prof. Boys, he was of opinion that greater concentration, and hence higher boiler temperature and pressure, should be employed in later absorbers of the Shuman type. From the Meadi plant nearly three-fourths of the brake horse-power theoretically possible was actually obtained (relative efficiency referred to Carnot cycle, 73.2 per cent.). The special type of Shuman engine developed for use with sun-absorbers consumes only 22 lb. per B.H.P.-hour of steam at atmospheric pressure, and, at 20-30 lb. per square inch, which seems to be the pressure range indicated by experience as most favourable, considerably better steam efficiency would be attainable. Pumps and condensers of such perfection are now available that there need be no appreciable wastage in using other vapours than steam, with water as the intermediate heating agent. The possibilities of two-fluid systems and of low-pressure turbines seem yet to have been very incompletely investigated.

Though heat is obtained "for nothing" in sun plants, the capital cost and depreciation of the latter are considerable. As the result of his 1913 investigations and subsequent experience with the Shuman engine, Mr. Ackermann concludes that the utilisation of solar energy is practically a solved problem "where there is plenty of sunshine and coal costs £3 10s. per ton." That statement takes full account of capital and depreciation charges, and it is assumed that silvered glass mirrors are used, since these are much more satisfactory in practice than metal reflectors. There is good reason to believe that considerably better results will be obtained in the next plant erected, and there seems nothing extravagant in the suggestion that solar heat will, in the near future, be equivalent to coal at £2 a ton. In many parts of the world coal is used regularly at this and higher prices, and it is a fortunate coincidence that where coal is dear, sunshine is often plentiful. Primarily, sun-power plant is best adapted to irrigation work, the availability of sun-heat and the necessity for irrigation being interdependent, but there is no reason to doubt that, once waste places of the earth, remote from coalfields and transport facilities, have been reclaimed by irrigation, the power and lighting requirements of the district can be supplied by solar-electric generation. In stimulating further research in this promising field and in preventing waste of time and labour in fruitless or already explored directions, Mr. Ackermann's latest paper should prove very useful.

NOTES FROM CANADA.

[From our Special Correspondent.]

A Dominion Government report giving statistics of the various telegraph systems operating in Canada has been issued recently.

There are twelve such systems, including those of the Marconi Wireless Telegraph Co. and the Dominion Government Telegraph Service, the latter operating in those outlying sections of the Dominion which are not served by commercial telegraph organisations.

The financial results of the working during 1914 have not been so good as they were in the previous year; the gross earnings (amounting to $5,983,204 in 1914) being $112,008 less and operating expenses $208,059 more, making a total adverse difference of $320,067; the operating expenses for 1914 were $4,242,539.

By far the larger share of business goes to the system of the Canadian Pacific Railway Co., that of the Great North-Western Telegraph Co. coming next with only one-third of the C.P.R. Co.'s business; these two concerns together handle about two-thirds of the total telegraph business of the Dominion.

The items of operating showing the greatest increases are "line and equipment" and "buildings," followed by "salaries and wages" and "stationery and printing," in order of importance.

Figures of pole and wire mileage are given, from which it is seen that the Province of Ontario leads, after which come Quebec, Saskatchewan, British Columbia, Alberta, Manitoba, and Nova Scotia. The ratio between pole mileage and wire mileage varies a good deal, from 1s. 6d. in Ontario to practically 1s. 3d. in Quebec; this is exclusive of the Yukon and Newfoundland, where the ratio is 1s. 1d., the conditions evidently being special. As a conductor, galvanised wire holds the first place, there being over 126,000 miles in use last year; next comes multiple, of which there were 43,000 odd miles, then copper, overhead, 21,600 miles, copper, underground, 737 miles, and copper, submarine, 653 miles.

INDIAN NOTES.

[FROM OUR SPECIAL CORRESPONDENT.]

Darjeeling Hydro-Electric Scheme.—Mr. Stonebridge, one of the partners of the electrical engineering firm, Messrs. Luke Stonebridge & Co., has been temporarily engaged by the Darjeeling Municipality to report further on the hydro-electric scheme on which the late Mr. Robertson was engaged when he was drowned. Originally, the two stations Lebing and Talapahar, and areas in between, were only to be provided with current, but in view of more extensive possibilities the temporary engineer is engaged in making observations and taking particulars in the Dam Dimma Valley, where it is conjectured several power-houses might be established and interlinked, so that sufficient power may be obtainable for the various tea gardens in the area right down to Nuxalbarie and Siliguri. It may not be outside the range of possibility to provide, at no distant date, sufficient cheap power to electrify the Darjeeling Himalayan Line. This is a 50-mile narrow-gauge line from Siliguri to Darjeeling, with an ascent of 8,000 ft. It now takes over seven hours to travel the zig-zag distance, and is not far off being one of the most expensive railway journeys in the Empire.

Cauvery Power Scheme.—Mr. A. G. Forbes, the chief electrical engineer, read a very interesting paper recently at the Mysore Engineers' Association, having for his subject the Cauvery Power Scheme. He went on to say that the fourth installation of 4,000 H.P. was almost completed; and this, with a similar installation proposed for next year's budget, would make over 20,000 H.P. generated from the Cauvery Falls. Since the first installation was put down several years ago the phenomenon of high-tension transmission has become of every-day use and hence the local problem of long-distance transmission has been made easy. Under a new agreement with the Kolar Mining Co., the Mysore Government are to supply them with 14,500 H.P. at the motor terminals—a distance of 92 miles away, with an option of 2,500 H.P. more on two years' notice being given. Mr. Forbes went on to say that as the Cauvery power scheme was the pioneer of its kind in India, the future of electrical development in this country was dependent on its unqualified success. He added that from an engineering and economic standpoint the Cauvery scheme was the most successful one in operation to-day.

NEW PATENTS APPLIED FOR, 1915.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

5,832. "Process for the manufacture of heating-conductors for thermic telephones." NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON MAATSCHAPPIJ. April 19th. (Convention date, February 6th, 1915, Germany.) (Complete.)

5,833. "Sound chamber for thermic telephones and the like intended to be introduced into the auditory passage." NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON MAATSCHAPPIJ. April 19th. (Convention date, February 8th, 1915, Germany.) (Complete.)

5,834. "Construction of heating-conductors for thermic telephones." NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON MAATSCHAPPIJ. April 19th. (Convention date, February 8th, 1915, Germany.) (Complete.)

5,835. "Process for the manufacture of heating-conductors for thermic telephones." NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON MAATSCHAPPIJ. April 19th. (Convention date, February 9th, 1915, Germany.) (Complete.)

5,836. "Thermic telephones." NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON MAATSCHAPPIJ. April 19th. (Convention date, February 10th, 1915, Germany.) (Complete.)

5,837. "Thermic microphone." NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON MAATSCHAPPIJ. April 19th. (Convention date, February 11th, 1915, Germany.) (Complete.)

5,838. "Thermic telephones." NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON MAATSCHAPPIJ. April 19th. (Convention date, February 11th, 1915, Germany.) (Complete.)

5,839. "Thermic telephone with adjustable sound effect." NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON MAATSCHAPPIJ. April 19th. (Convention date, February 12th, 1915, Germany.) (Complete.)

5,840. "Thermic telephones." NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON MAATSCHAPPIJ. April 19th. (Convention date, February 12th, 1915, Germany.) (Complete.)

5,841. "Mounting for thermic telephones." NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON MAATSCHAPPIJ. April 19th. (Convention date, February 12th, 1915, Germany.) (Complete.)

5,842. "Heating-conductors for thermic telephones." NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON MAATSCHAPPIJ. April 19th. (Convention date, February 13th, 1915, Germany.) (Complete.)

5,843. "Heating-conductors for thermic telephones." NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON MAATSCHAPPIJ. April 19th. (Convention date, March 6th, 1915, Germany.) (Complete.)

5,844. "Process for the manufacture of heating-conductors for thermic telephones." NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON MAATSCHAPPIJ. April 19th. (Convention date, March 6th, 1915, Germany.) (Complete.)

5,845. "Thermic telephones." NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON MAATSCHAPPIJ. April 19th. (Convention date, March 17th, 1915, Germany.) (Complete.)

5,846. "Thermic telephones." NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON MAATSCHAPPIJ. April 19th. (Convention date, March 17th, 1915, Germany.) (Complete.)

5,847. "Thermic telephones." NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON MAATSCHAPPIJ. April 19th. (Convention date, March 17th, 1915, Germany.) (Complete.)

5,848. "Commutators." T. ZIMMERMAN. April 19th. (Convention date, April 17th, 1914, United States.) (Complete.)

5,853. "High-speed rotating bodies." BRITISH THOMSON-HOUSTON Co., LTD. April 19th. (General Electric Co., United States.)

5,865. "Ignition devices for starting internal-combustion engines." R. BOSCH (firm of). April 19th. (Convention date, April 17th, 1914, Germany.) (Complete.)

5,866. "Lanterns for electric lamps." R. BOSCH (firm of). April 19th. (Convention date, June 15th, 1914, Germany.) (Complete.)

5,870. "Production of zinc or other metals by electrolysis." M. PERREUR-LLOYD. April 19th. (Addition to 4,625/15.) (Complete.)

5,875. "Portable telephone and telegraph instruments." INTERNATIONAL ELECTRIC Co., LTD., R. G. LE NOIR, and E. FUNCCIUS. April 19th.

5,879. "Combined electric switch and wall plug." W. H. STURGE. April 20th.

5,883. "Method of obtaining a sparkless break of an inductive electric circuit." T. F. WALL. April 20th.

5,887. "Electrical conductors." A. MARR & J. LISTER. April 20th.

5,889. "Electric heating-element." CABLE ACCESSORIES Co., LTD., & F. H. REEVES. April 20th. (Complete.)

5,909. "Telephone call recorder." F. P. REID. April 20th.

5,918. "Windings for electrical machines." BRITISH THOMSON-HOUSTON Co., LTD. April 20th. (General Electric Co., United States.)

5,935. "Process for the electro-deposition of zinc." S. O. COWPER-COLES. April 20th.

5,936. "Solder." S. O. COWPER-COLES. April 20th.

5,937. "Process for the electrolytic coating of sheets and plates with other metals." S. O. COWPER-COLES. April 20th.

5,938. "Manufacture of electrolytically-coated metal plates." S. O. COWPER-COLES. April 20th.

5,943. "Electric switches." G. GILES. April 20th. (Convention date, April 24th, 1914, Germany.) (Complete.)

5,955. "Polyphase generators for high-frequency currents with polyphase tuned spark gap." L. ROUZET. April 20th. (Addition to 519/15. Convention date April 20th, 1914, France.) (Complete.)

5,964. "Combined automatic electric taximeter, flag, and fare dial illuminator with reflector." G. S. LYSAGHT. April 21st.

5,969. "Thermostats." H. E. MOUL. April 21st.

5,992. "Generator of mechanical and electrical power by different currents." D. SUCHOSTAWER. April 21st.

5,994. "Sound transmitter." C. STILLE. April 21st. (Complete.)

6,003. "Electro-magnetic driven pumps." E. BACHELET. April 21st.

6,055. "Lamp-sockets and lamp-holders for incandescent electric lamps." E. EDSER. April 22nd.

6,063. "Signalling or telegraph apparatus." R. H. WALKER & J. J. WALKER. April 22nd.

6,066. "Separators or covers for the plates of secondary batteries." ELECTRICAL POWER STORAGE Co., LTD., & C. C. RATTEY. April 22nd.

6,086. "System of control for maintaining the relative speeds of a number of electric motors." F. C. ANDERSON & C. A. ATCHLEY. April 23rd. (F. G. Warburton, Canada.)

6,093. "Lead jointing-sleeve for electric joints." C. J. BEAVER & E. A. CLAREMONT. April 23rd.

6,096. "Carriers for electric hand lamps." ASSOCIATED PORTLAND CEMENT MANUFACTURERS (1900), LTD., & C. P. TAYLOR. April 23rd.

6,098. "Electric generating set." A. COLLET. April 23rd. (Convention date, April 30th, 1914, France.) (Complete.)

6,117. "Electrical distribution apparatus." W. T. HENLEY'S TELEGRAPH WORKS Co., LTD., & E. E. JUDGE. April 23rd.

6,135. "Construction of insulated conductors for electrical purposes." J. I. HALL. April 24th.

6,151. "Magnetic brakes, clutches, and the like." F. NEWTON & NEWTON BROTHERS (DERBY), LTD. April 24th.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1914.

136. ELECTRIC HEATER. J. R. Quain. January 2nd.

399. SUBMARINE TELEGRAPHY. J. S. Withers (Cox). January 6th.

3,221. ELECTRIC WATER-HEATERS OR GEYSERS. J. R. Quain. February 6th. (Cognate applications, 8,019/14 and 14,394/14.)

8,049. TELEPHONE TRANSMITTING APPARATUS. J. J. Comer. March 30th. (March 31st, 1913.)

8,505. ARC-LIGHT CARBONS. H. Ayrton. April 3rd. (Addition to 22,319/13.)

8,804. ELECTRIC WELDING. E. H. Jones and Light Steel Tubular Wheels, Ltd. April 7th.

8,946. AUTOMATIC OR SEMI-AUTOMATIC TELEPHONE SYSTEMS. G. A. Betulander, N. G. Palmgren and O. Grahn. April 8th.

9,411. ELECTRIC RESISTANCES. F. Celeri. April 16th.

12,912. TELEPHONE SWITCHING APPARATUS. Western Electric Co. May 26th. (F. T. Woodward acting for Western Electric Co.)

14,577. SYSTEMS OF ELECTRIC DISTRIBUTION. British Thomson-Houston Co. June 17th. (General Electric Co.)

14,841. ELECTRICITY METERS OF THE MERCURY MOTOR TYPE. Chamberlain, Hookham, Ltd., and W. S. Sprague. June 20th.

17,590. TELEPHONE SYSTEMS. Automatic Telephone Manufacturing Co. and A. B. Sperry. July 24th. (Divided application on 1,970/14. January 24th.)

17,945. ELECTRIC HEATERS. R. Weaving, F. Smith, & Ferranti, Ltd. July 29th

18,106. ELECTRIC CURRENT GRADUATING DEVICES OR RESISTANCES. W. Sumner. July 31st.

22,261. APPARATUS FOR ELECTRIC RIVETING AND HEADING. F. P. Kobert. November 9th.

24,780. ELECTRICALLY-OPERATED ALARM APPARATUS. J. F. X. Miller. December 30th.